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New Advertisements.

In the growth of THE ELECTRICAL WORLD in circulation, size and general improvement, the value of its columns for reaching those engaged in electrical pursuits or interested in electrical matters has not failed to be appreciated by advertisers. Readers will find it to their advantage to keep their eyes on the advertising as well as the reading columns. The following are the new advertisements in this issue:

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Vol. IX. NEW YORK, MARCH 26, 1887. No. 13.

So great, rapid and persistent is the growth of the West that the condition of business there may to-day be said to largely determine the state of trade elsewhere throughout the country, even in the South, which is dependent in its revived activities upon Western men and money, to a considerable degree. With the conviction that the spring outlook in the West and South might well be taken as a sign and evidence of the general state of things, and would serve as a promise for the year, we have made a canvass of the electrical business in both sections, and give the results elsewhere. Our Western representative reports, as usual, for a very large area of country, and the special correspondence he has secured from a number of points goes to fill out the picture he sketches. It will be seen that electrical trade is generally very active, and that it may be expected to remain excellent for an indefinite time to come. Our readers will find this correspondence very interesting and full of news and suggestions. The paper contains also a number of articles of interest relating to the West, including one on the new electric railway at Denver.

AN important rumor comes from Washington to the effect that at the next session of Congress Senator Cullom intends to bring in a bill subjecting telegraph companies to such regulation as is now placed upon railroad operation by the Inter-State Commerce law. There is believed to be considerable warrant for the report. The telegraph companies are therefore amply forewarned. Should such a law be passed, it is to be hoped that its provisions will generally be clearer as to their meaning than those which the railroad companies are now endeavoring to comprehend and evade.

ELECTRIC LIGHTING is undoubtedly in greater demand in England than it has been for some time past, and the prospects are much brighter. The Maxim-Weston Company at its annual meeting just held declared its third consecutive dividend, at the rate of 5 per cent. for the year, and Mr. Hugh Watt, the chairman, said that they could already look upon as closed for the coming year business amounting in the aggregate to nearly as much as that done in 1886. As showing how much depends on favorable legislation, he stated that in Lancashire, Cheshire and North Wales they could do five times as much business during the current year, if the new bill became law, setting them free from the grossly unjust restrictions of 1882. Another indication of better times is also seen in the activity reported at the Elwell Parker works, Wolverhampton, where some 250 hands are employed on accumulators and dynamos; in the briskness displayed in ship lighting, and in the more general desire of the public for such improved lighting as can only be supplied with the aid of electricity.

IT is so rarely that Prof. Bell is heard in public that his recent lecture at Cornell University is deserving of notice. His topic was the telephone and the photophone, and both were treated in an elementary, though highly able, manner. Some of the remarks of the speaker were quite characteristic. Thus Prof. Bell seems to look upon the telephone as not a highly sensitive instrument, but on the contrary, he deems it a wonder that we can hear speech with it at all. It is the *ear*, he says, which is the organ of marvelous delicacy, and which alone makes the telephone practical. Speaking of photophony, Prof. Bell remarked that the first successful experiment was made in Washington, the transmitter, with the source of light, being placed in his laboratory, 500 yards distant from the receiving station. The first message ever transmitted by this new servant of man was: "Mr. Bell, if you hear what I say, come to the window and wave your hat." Prof. Bell, it is needless to say, waved the hat with vigor, and he remarked truly that "the feelings that arise within one when, after vast labor, a great problem is solved, or invention produced, and fraught with so much success, no one can express; they are moments worth a life to live for." It is a great pity Prof. Bell is not oftener to be seen and heard in the capacity of a lecturer. He has much to tell, out of years of experiment, that would be full of the greatest interest and weight.

IT is now reported that the Baltimore & Ohio "deal," to which we have had occasion to make reference lately, has been carried through, and that its consummation will lead to the formation, as already outlined, of a strong telegraph organization including the Baltimore & Ohio and United Lines plants. As to the service that has been so ably managed by himself, President D. H. Bates has recently made some very remarkable statements. He denies flatly the story of working at a loss, and says that, on the contrary, the Baltimore & Ohio Telegraph Company last fiscal year paid over to the railroad company a large sum as clear profit, besides paying for all telegraph supplies required for the train service. Since 1884, the mileage has increased threefold, the revenue four and a half fold, and the traffic nearly sevenfold. He says, moreover: "We are to-day handling a larger gross traffic than that handled by the Western Union in 1869, but at that time the mileage of the Western Union was double what ours now is, and it then cost them three times as much to perform the same service as it now costs us. Within the past three years, during which our company has been most active, the net revenue of our chief competitor has fallen $6,000,000, compared with the three years immediately preceding, while, on the other hand, it has expended during the first named period for additional wires and plant nearly as much as the whole cost of the Baltimore & Ohio telegraph system beyond the line of the Baltimore & Ohio Railroad, and the fixed charges of our rival have enormously increased, reaching now the fabulous total of about $60,000,000, calculated at five and a half per cent. per annum. The Baltimore & Ohio Telegraph Company is greater in mileage than both the Atlantic & Pacific and the American Union Telegraph companies together, which were sold to the Western Union Company six years ago for $28,240,000, although they never paid their working expenses. It is twice as great as these companies were in volume of traffic and far more efficient for work." This is a striking record, and one that could only be due to great executive ability well backed by the confidence of capital and the devotion of a competent staff and force.

THE variety of topics touched upon by Prof. Elihu Thomson in the discussion on secondary generators, given on another page, showed that he is a thorough master of the subject. The important question of safety, or rather danger, to life in connection with the employment of the system, was ably treated by him, and enthusiastic admirers might well nigh have been convinced that alternating were safer than continuous currents. From Professor Thomson's remarks, as to the experiments he has been subjected to, it would appear that he is of the opinion that there is no greater danger in alternating currents than in the direct. It all seems to depend upon the power of the person coming in contact with the wires to draw or tear himself away; if he is unable to "sever his connection," serious consequences occur with either form of current if of sufficiently high potential. Regarding the relative efficiency of the secondary generator and the dynamo, Professor Thomson corroborated Mr. Mailloux in the statement that one of the main reasons must be looked for in the absence of all "dead wire." He had found by experiment that an E. M. F. of 1 volt. was generated for from 6 to 12 inch length of wire in the secondary; which is but one-half the length found to be necessary in dynamo construction for length of wire on armature per volt. This, together with the rapid rate of magnetic change due to the alternations, must be looked upon as the chief cause of high efficiency.

CONSIDERING the fact that the application of secondary generators to electrical distribution is in the infancy of its application in this country, and in view of the amount of general attention which it is attracting, the discussion at the last meeting of the American Institute of Electrical Engineers was an eminently timely one. The vigorous manner in which those who are introducing this system here are proceeding in their work has, naturally, caused all interested in electric lighting to consider what the advantages of this system are, and wherein it may claim superiority over those already in use. Dr. Moses, following much the same line of argument that he employed in Philadelphia recently, while on the same subject, began with the dynamo, and showed that in the absence of the commutator in alternate current machines much of the difficulty experienced in the continuous current type is removed; and he saw in the alternating current machine, the first practical type of dynamo, the machine of the future. He even saw in the future the obtaining of continuous currents from such machines without a commutator, so called, so that nothing would stand in the way of the employment of such machines for all purposes. Whether these much-to-be-desired points will all be realized is a problem of considerable interest, though one, it seems to us, with no immediate prospect of solution. So far as continuous current machines are concerned, the danger and wear from sparking is more a thing of the past than one to be feared in the present. Well-designed machines built to-day, after years of experiment, leave little to be asked in the matter of sparking. With regard to the next point of superiority advocated for the system, viz., the saving in conductor effected. Mr. Church seemed to think that it was not putting it in the right form to claim the saving of copper as the *great* advantage. He contends that the proper manner to view this question is to consider that the system permits of a central station supplying a larger number of customers than the direct system can do with economy. The question of conductor is, of course, involved in this consideration, but its ulterior place in the problem as generally presented, he claims, is not clearly enough defined. Mr. Church was led to make his able remarks as a reply to the opinions expressed by Siemens and Halske, and quoted by one of the speakers, to the effect that the secondary generator system of distribution was not as economical as the ordinary two-wire system. Siemens and Halske assert that the system is not suitable for a general distribution, and that when underground wires are employed the difference in the fixed charges between the two systems practically disappears. Hence, they claim that this is the reason why the projectors of the new system always figure on overhead wires, which, as they maintain, cannot serve the purpose for a house-to-house distribution. Thus far the installations on the induction system in this country are all overhead, but it remains to be seen whether the points of advantage claimed remain when underground work is undertaken. We are ourselves very much impressed with the manner in which the alternating current system is gaining adherents and supporters, an indication, certainly, of strong recommendations or the score of efficiency and economy.

Balloon Signaling.

BY WM. A. J. KOHRN.

In a recent issue of THE ELECTRICAL WORLD it is stated that an English inventor will soon test his apparatus by signaling across the Channel. In regard to the nature of the "invention," the article says that the balloon is made of a translucent material, filled with hydrogen gas. In the interior are placed several incandescent electric lamps. The balloon is to be held captive, and in the circuit on the ground is a key for making and breaking contact rapidly; by varying the duration of the flashes of light in the balloon, it is possible to signal by the Morse or any other code.

It is not my intention to enter into any argument concerning the possibility of the scheme. On the contrary, I desire to call attention to the fact that the idea is by no means a new one. The same thing was conceived and suggested by me several years ago. Indeed, Professor Edwin T. Owings, a well-known aeronaut, and myself have concluded to put the electrical method of balloon illumination into practice. We are at present engaged in San Francisco in the construction of a hydrogen balloon of 35,000 cubic feet capacity, the interior of which will during inflation at night be brilliantly illuminated by means of one or more incandescent lamps fed by a primary battery. The lamps, fixed within a sealed glass globe, will be suspended in the centre of the balloon by means of cords running through a small pulley attached to the valve frame overhead. The battery, together with a circuit breaker, is to be placed in the aeronaut's car.

By this means the course of the balloon can, if continually illuminated, be easily watched by those on *terra firma*. Likewise, by making and breaking the circuit, telegraphic messages can be sent to earth from great altitudes, and in any part of the country over which the voyagers may be sailing, provided, of course, that the atmosphere be sufficiently clear. These messages, if the ordinary Morse code is used, may be read by any telegraph operator on the *qui vive*, and even replied to in a similar manner. The aeronaut would thus have no difficulty in ascertaining his whereabouts, and the nature of the country below.

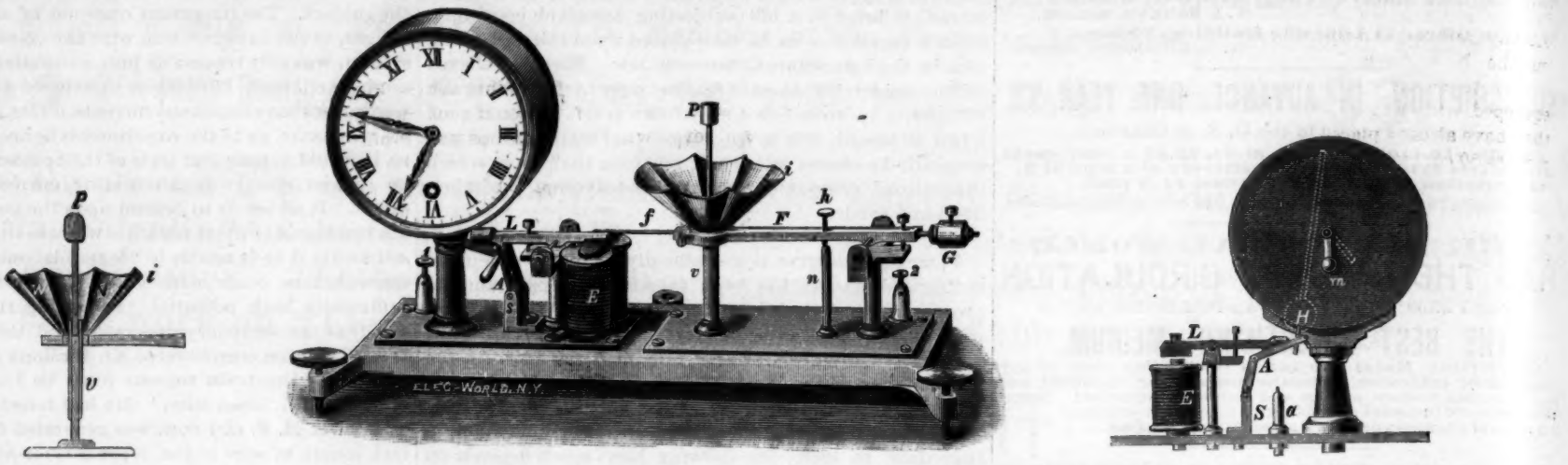
As soon as our air ship, the "Venus," is completed, we purpose testing the apparatus by making a "cut-loose" ascension, and exchanging flashes with a fixed station at the starting point as long as it remains visible.

Studying Earthquakes by Electricity.

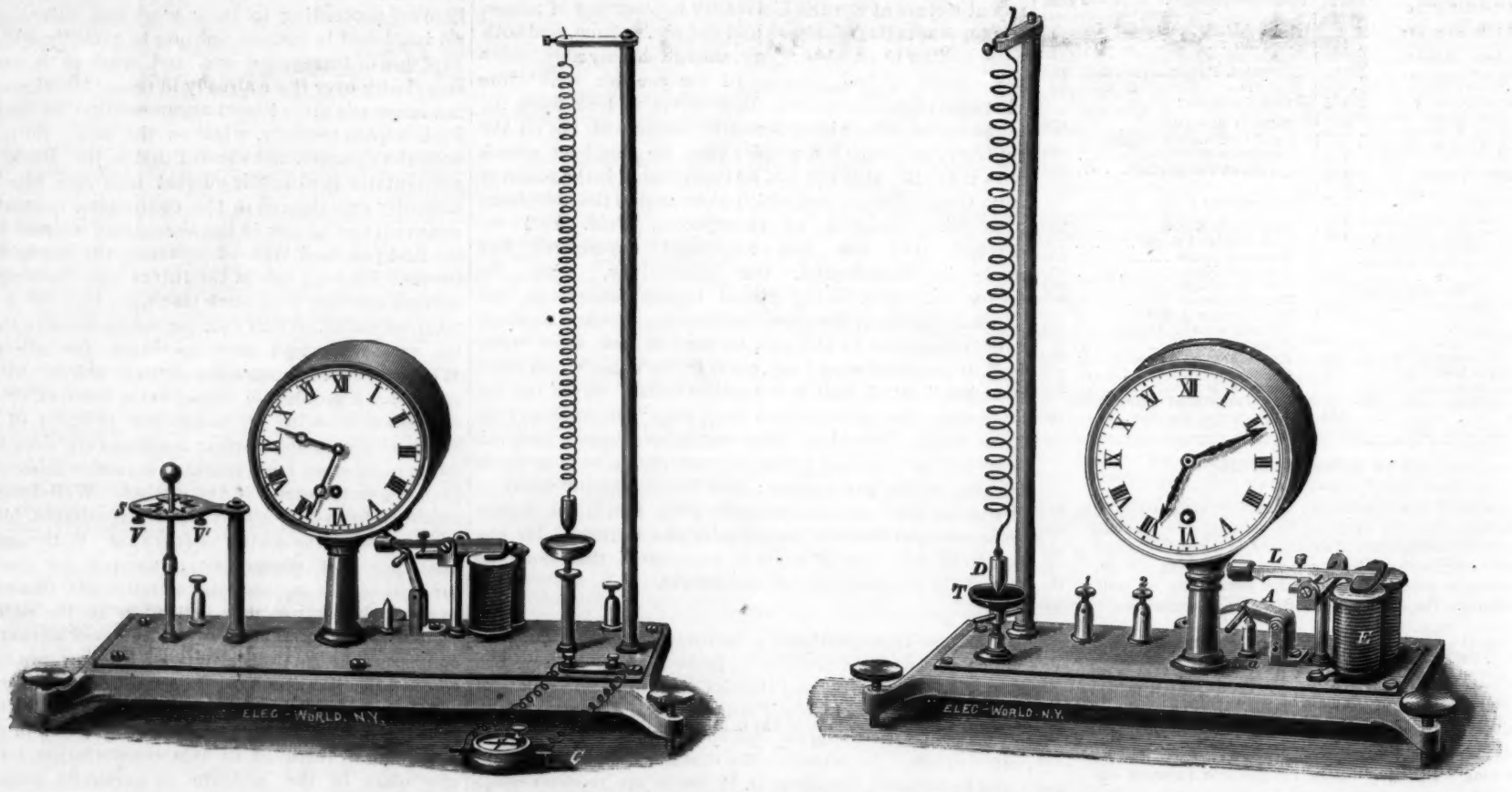
(*Continued from page* 143.)

In Fig. 10 the apparatus just described is shown combined with the clock on the same base. In this case the perforated disc is replaced by an octagonal funnel *i*, somewhat similar to an inverted umbrella, which surrounds, though without touching, the rod for the weight *P*, or the sleeve on the post. As shown by the vertical section, Fig. 11, the principle of the apparatus is the same as in the preceding form, the weight being cylindrical instead of globular. The funnel is not stationary, but can move up and down with the oscillating arm *F*, at one end of which it is held by a screw clamp. This arm is pivoted on pointed screws, like the armature lever of a Morse sounder, and the extent of its movement is controlled by screws, one of which (*h*) also serves to close a contact whenever that end which carries the funnel is depressed by any additional weight sufficient to overbalance the weight *G* placed at the other end. By loosening the screw of the clamp, the funnel can be turned until the recesses between the ribs of the funnel correspond with the points of the compass. The mechanism for starting the clock is put outside the clock. As seen from the rear view (Fig. 12) the pendulum is held back by a curved arm *A*, which is engaged by a catch on the end of the armature lever *L*. When the electro-magnet *E* receives an impulse of current, the armature lever *L* moves upward and releases the curved arm *A*, which falls down, leaving the pendulum free to swing. The same precautions are necessary as with the preceding instrument. The post on which the rod supporting the weight stands must be brought to a truly vertical position by means of the leveling screws. The connections are made as before. When an undulatory disturbance occurs, the weight falls into one of the recesses in the funnel, thereby indicating the direction of the undulation. At the same time, by the increase of weight of the funnel, the arm *F* is depressed, and the electrical circuit is closed at *h*. The electro-magnet *E* is thereby brought into action to start the clock, while the falling of the pendulum arrester *A* closes a local circuit at *a* (Fig. 12), which operates an electric bell. The small prolongation *f* attached to the lever *F* rests upon the armature of the electro-magnet, and in this way the fall of the weight *P* itself is made to assist the process of starting the clock. The apparatus for subsultory impulses can also be combined in a similar manner, as will be seen in Fig. 13. In Fig. 14 both the subsultory and undulatory "annunciators" are combined on one stand. In this case the form of undulatory apparatus shown in Fig. 7 is reverted to. As it would be inconvenient, however, to shift the position of the base of the apparatus for the purpose of making the points of the star indicate the directions of the compass, the star is made movable, and by loosening the screws *V V'* it can be turned to the desired position. It sometimes may happen that an impulse of one kind may be followed not long after by one of the other kind. Now, if the attendant, when he arrives, finds the clock running and the small weight still on the rod, he knows that there has been a subsultory impulse. But if, on the other hand, he found the ball down, he would be at a loss to know whether the undulatory impulse came alone or was accompanied by a subsultory impulse. This is because the subsultory disturbance merely sends an impulse of current through the circuit; and the suspended weight when it comes to rest leaves no indication of the occurrence of the disturbance. Such an indication is here obtained, however, by very simple means. An ordinary testing galvanometer *G*, is connected in the circuit of the subsultory apparatus, so that the impulse of current will go through it when the subsultory disturbance causes the weight to dip into the mercury, thereby closing the circuit. The side to which the needle will be deflected by this impulse having been determined by previous trial, a piece of iron is placed on that side of the needle and at such a distance that when the needle is deflected its end will come in contact with the piece of iron. This piece of iron passes through a hole in the glass cover of the galvanometer, being fastened to the thumb-nut which is seen in the figure. The glass cover is free to turn in the case of the galvanometer, and by using the thumb-nut as a winch the iron piece attached to it can be moved around to any desired distance from the zero point of the instrument. When the contact at the mercury cup is closed by a vertical shock, the impulse of current throws the galvanometer needle in the direction of this iron rod and the needle is attracted by it and there held until released, thus giving an indication of the occurrence of a vertical disturbance.

(*To be continued.*)



FIGS. 10, 11 AND 12.—STUDYING EARTHQUAKES BY ELECTRICITY.



FIGS. 13 AND 14.—STUDYING EARTHQUAKES BY ELECTRICITY.

Car Lighting by Means of Storage Batteries.

BY J. O. ELLINGER.

The recent railway accidents, followed by the burning of the wrecked cars from the upsettin of stoves and the breaking of the oil lamps, have aroused some of the railroads to a realization of the fact that the public demands safer means of lighting and heating. The latter is therefore to be accomplished by steam, and I am very glad to note that several roads have made an earnest start as to the latter, in the application of the storage batteries to the lighting of their trains.

Within the past two months the Julien Electric Company has equipped cars for electric lighting by means of its storage batteries and with eminent success.

The two railroad companies who have so promptly responded to the public demand for safety are the Boston & Albany Railroad and the Wagner Parlor Car Company, on the New York Central & Hudson River Railroad. Owing to delays of various kinds but one car has been equipped with storage batteries by each company, but they have already placed large orders, so that within five months 50 cars will be equipped on the Boston & Albany road, and a large number for the Wagner Car Company.

The car equipped for the Boston & Albany Railroad is a passenger car, furnished in plain polished mahogany, and hence, owing to the absorption of much light, is difficult to light up. This car is attached to the regular train, on what is known as the Newton circuit.

The total number of lamps in use is 24. Eighteen of these are arranged in two rows, nine on each side on the interior of the car, and there is a lamp in each vestibule. All these lamps are attached to the monitor roof, so that they come about midway between two persons occupying adjoining seats, thus giving each one an unobstructed light.

The lamps are each 16 c. p., and are absolutely steady in their action, the process of applying or releasing the brakes not causing the slightest flicker. In addition to the lamps in the interior of the car, there are two lamps on either platform, which are arranged to burn either at all times or when the train stops to take on or drop passengers, thus minimizing the liability to accidents resulting from dark platforms.

The entire 24 lamps in this car are calculated to be lighted ten hours per day, so that enough battery has been installed to supply 240 ampère hours. To do this 60 cells are employed, arranged in ten boxes of six cells each. The boxes are carried in specially arranged compartments on the bottom of the car, five on either side. On the bottom of the boxes containing the cells, all of which are in series, are two strips of copper, connected with the first and last cell. The bottoms of the compartment carrying the boxes are so arranged that when the boxes are placed in position the cells in the different boxes are automatically connected. In this manner the untrained laborers can replace the discharged cells with those freshly charged without requiring an expert to supervise the work.

The Boston & Albany Railroad has arranged to have its batteries charged while on the car, so that only one set of cells is used. The Weston Electric Company, of Boston, have contracted to charge the cells at the rate of 75 cents per day. The batteries are charged with a current of 20 ampères for 9 hours, so that 180 ampère-hours are put into the batteries each day. The cost of charging could be greatly reduced were the company to supply its own current and charge a large number of batteries at one time.

The Wagner Parlor Car Company have also fitted their beautiful parlor car, the "Olga," running on the 6 o'clock train to Albany, with the Julien battery. This car leaves New York at 6 P. M., and returns the following day at 3:28 P. M. The lamps are required to burn about 5 hours each day, so that 30 cells are placed on the car. The arrangement of the cells in the car is similar to that described above in the case of the Boston & Albany car. This car, the "Olga," is supplied with two sets of batteries, so that one set is charging while the other is discharging. They are charged from the Edison dynamo, which supplies the lights in the Grand Central Depot in New York. The lights in the station are utilized from dusk to 1 A. M., so that the plant ordinarily would be idle from 16 to 19 hours per day. During this time, were all the cars equipped with the storage batteries, the dynamos could be utilized to charge the batteries at a very small additional expense. The batteries now in use are charged with 18 ampères from 1 A. M. to 11 A. M., in all 10 hours. The trays supporting the charging cells are arranged precisely as the compartments on the bottom of the car holding the boxes, so that when the boxes are placed on the trays electrical connection between the cells in the different boxes is at once established.

There are 24 lights on the "Olga." Of these there are 2 on each platform, 14 in the main body of the car, 3 in the smoking room, 2 in the closets, and 1 in the corridor. The circuits on which they are placed are so controlled by switches that all the lights may burn at once; the platform or the closet lights or both may be turned off while the others are burning; and still another switch provides for throwing off eight lights in the body of the car and two in the smoker, in which case only seven lights are burning, so that in case of any great delay, by turning off the 17 lights, the remaining seven will burn a proportionately longer time.

The illumination of this car is admirable, and the steadiness with which the light burns is marvelous. The only objection urged is that of the car cleaners, who object to the brilliancy of the light, which calls for their most thorough attention in the cleaning of the draperies and woodwork of the car. With the oil lamps, such care was not required.

As soon as possible after the arrival of the car in the depot, it is essential that it be quickly removed, in order to allow other trains to enter the depot; so that the discharged batteries must be shifted and the charged ones placed in position very rapidly. After two handlings of this kind, the shifting was effected in 7 minutes, which time, after the men become more familiar with their work, will be greatly reduced.

The "Olga" was equipped at the car company's shops at Buffalo. The cost of wiring, boxes and lamp fixtures was $150; the cost of 60 cells, at $13 per cell, was $780, making the total cost of the installation $930.

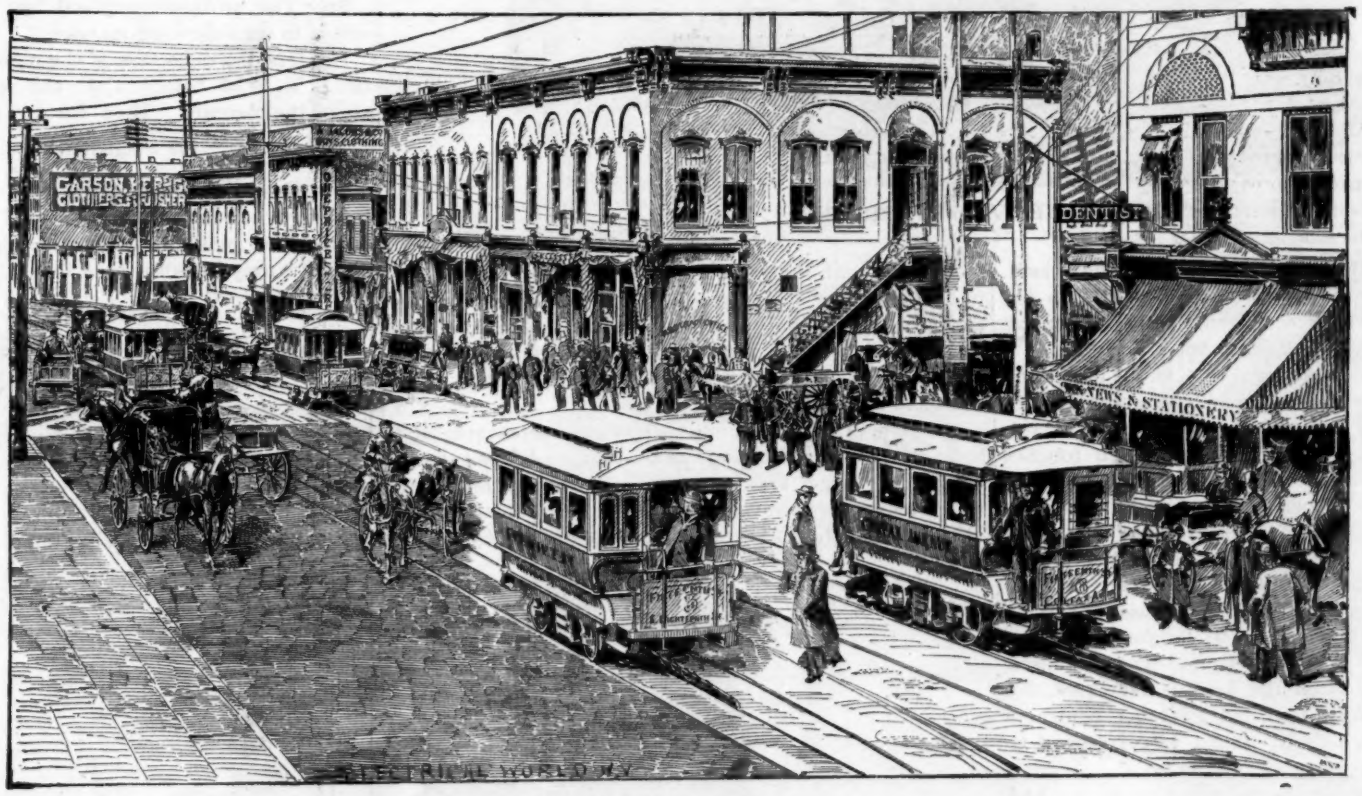
The Julien Electric Company guarantee their battery for two years. The actual life of the battery is probably much longer, as, upon examination of the plates two years after use, they have shown no apparent depreciation.

In calculating the cost of lighting by this system, it is assumed that the depreciation is 50 per cent. per year, and at the end of two years the batteries require renewal; the negative plates will be in as good condition as when first used, and the only cost for renewal would be the cost of positive plates and the cost of fabrication. This latter amount would be offset by the price of the metal in the positive plate, so that the apparent depreciation of 50 per cent. would be reduced to 25 per cent. per year. Assuming that it is 30 per cent., it can then be estimated within a fraction of a cent the cost of operating one 16 c. p. lamp per day. Using the figures obtained from the Boston & Albany Railroad, we have:

60 cells, at $13, cost $780, depreciation at 30 per cent. =	$234.00
24 lamps, at 85c, cost $20.40, if each lamp lasts 2 months, 6 renewals per year would be required at $20.40 .. =	122.40
Charging battery, 365 days, at 75c..... =	273.75
Interest on $930, cost of installation, at 4 per cent. .. =	37.20
Total cost for 24 lamps per year.....	$667.35
Cost of 24 lamps one day.....	1.83
Cost of one lamp per day.....	7.63 cts.

In this estimate the outside figures have been taken, as, for instance, with the lamps, whose life was exhausted at 600 hours. The average life is far above this. Again, 75 cents for charging is at least 50 per cent. higher than would be the actual cost were the companies to charge their own batteries.

The officials on the different railroads estimate that the cost of an oil lamp, including depreciation, breakage, oil and attendance, is about 15 cents per lamp per day. At this rate, the companies could afford to replace each oil lamp with two electric lamps, without any increase in the cost of lighting the car, and add materially to the comfort and safety of their patrons.



STREET SCENE, ELECTRIC RAILWAY, DENVER, COL.

The Electric Railway at Denver, Col.

Reports that have aroused curiosity have been received from time to time regarding the electric railway at Denver, Col. We give to-day, on this page, a street scene illustrating the road now in successful operation, on what is known as the Short-Nesmith system. The road is notable for working on the series plan, as devised by Prof. S. H. Short and carried out by him with the assistance of Mr. J. W. Nesmith. The Denver Tramway Company, to which the road belongs, has 3½ miles fully equipped, with seven cars running regularly. The conduit is of iron, with a ¼-inch slot, and contact is maintained in an ingenious method, of which more will be said in a later issue, by means of the projecting current collector shown. Brush motors are being used, and the ordinary street car wheels and axles are provided with an iron frame supported on spring pedestals, upon which the motor is fastened. On the motor shaft is a pinion driving a gear wheel on a short counter-shaft. This counter-shaft carries another pinion meeting with a large toothed gear wheel keyed to the axles of the car wheels, the ratio of pinion to gear being 1 to 5. The car body and truck are independent, and existing rolling stock can easily be adapted to the new method of propulsion. The station plant consists of a Lane and Bodley engine, a 100 h.p. Brush dynamo and a 100 h. p. Short automatic dynamo for constant current. The cars make an average speed of six miles an hour, but have easily made twenty-five miles an hour at night when the streets are clear. The cars are lighted by incandescent lamps, which derive current from the conduit, as does an alarm gong for warning foot passengers of the approach of the cars. The progress of the work has been followed with great interest by the citizens, and the patronage of the road is large and rapidly increasing.

A Pocket Daniell Cell.

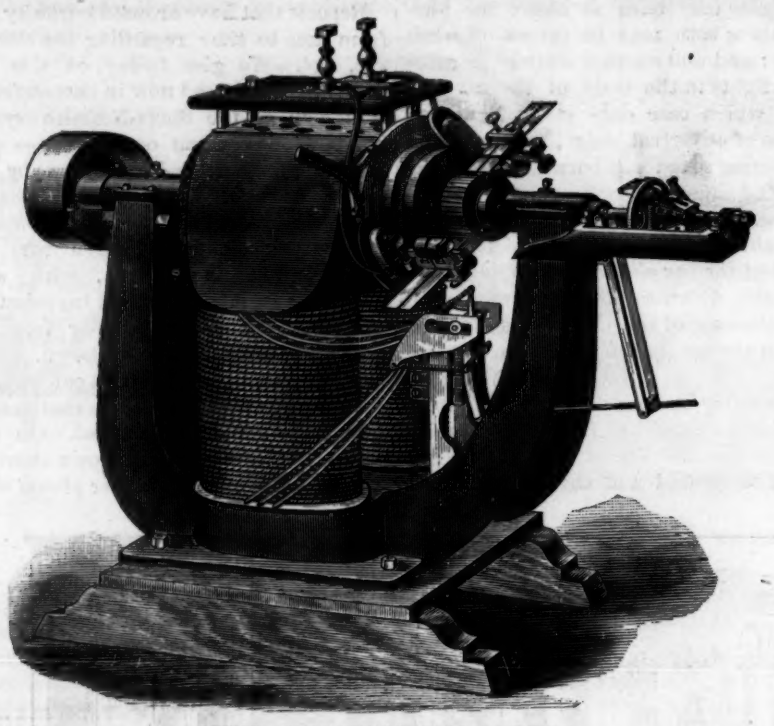
Dr. Edelmann, of Munich, has, says the London *Electrician*, recently devised a convenient little pocket Daniell battery consisting of two pairs of zinc and copper plates, each 12 c.m. by 7, separated by sheets of prepared Swedish filter paper. The paper is prepared by dipping it into a hot solution of gelatine and then covering it on one side with powdered sulphate of copper, and on the other with powdered sulphate of zinc, drying and cutting it to the size required. When required for use the paper is steeped for a few moments in water until the gelatine is softened, and the sheets are then laid between the metal plates, and the whole fastened together by india-rubber bands. The battery has an E. M. F. of 2.14 volts, and gives through an external resistance of 1 ohm a fairly constant current of .5 ampère, and is very useful for such purposes as the determination of resistances or the detection of faults of insulation.

Ticker Troubles in New York.—Wall street was surprised this week by a sudden movement in the "ticker" fight, which beings the New York Stock Exchange and the Consolidated Stock and Petroleum Exchange face to face in a legal fight. The stay of execution obtained by the Commercial Telegram Company when beaten in the suit brought to prevent its furnishing quotations, expires this week, and until now the Stock Exchange and the Gold & Stock Telegraph Company expected an easy victory. Late on Saturday, March 19, however, counsel for the Consolidated Stock and Petroleum Exchange obtained an injunction restraining the New York Stock Exchange from in any way interfering with the wires or tickers of the Commercial Telegram Company, which the Exchange had threatened to throw out.

Hochhausen's Electric Motor.

The demand for motors on arc light circuits or for constant current has led Mr. Wm. Hochhausen, the electrician of the Excelsior Electric Company, to design a machine, which, with fixed brushes, should regulate so as to keep constant speed with a variable load, and without the interposition of external resistance. The motor, which is illustrated in the accompanying engraving, has a single magnetic circuit in which the armature is included. The latter is mounted on bearings at the top of two arms which rise from the base, which also constitute the bearing of the electro-magnets, which have wrought-iron cores and cast-iron pole pieces.

The regulation of the motor is effected by varying the intensity of the magnetic field to correspond with the load. For this purpose the two field coils are divided into ten sections, the ends of which are brought to consecutive strips, shown at the side of and below the armature.



NEW HOCHHAUSEN MOTOR.

The governor is of the centrifugal type and is held in an extension bearing at one end of the armature shaft. The governor acts upon an arm which extends downwardly and operates upon a contact maker which touches the various contact strips to which the field coils are connected. Thus, when the motor, which is series wound, runs with full load and at normal speed, all the sections of the field coils are in action; as the load diminishes the governor expands from the momentarily increased speed and cuts out successive coils in the fields. This reduces the magnetic strength of the latter, and brings the motor back to the same speed as before. Conversely, when the load is increased, the speed is reduced for an instant, the governor contracts and puts additional field coils in circuit to correspond to the increased load.

The action of the governor is quite sensitive, as we had occasion to witness recently, and Mr. Hochhausen asserts that the regulation is within 2 per cent. between full load and no load.

The machine illustrated is designed for 3 h. p. and runs at 2,000 revolutions per miuute, taking a 10 ampère current, such as is largely employed in arc lighting. Its weight is 250 pounds.

The resistance of the armature is 1 ohm and that of the full field also 1 ohm. Hence the energy lost in the motor when running at full speed, with 10 ampères, is 200 watts, and as the motor delivers 3 h. p., or 2,238 watts, its efficiency is thus about 90 per cent. When the motor runs without load all the field coils are cut out, so that the resistance is that of the armature alone, or 1 ohm. In that case the energy absorbed by the motor is 100 watts, or little over ¼ h. p.

Various sizes of the constant speed machine illustrated are in course of construction, one of ten horse-power weighing 600 pounds.

Mr. Hochhausen has also designed a motor of somewhat similar appearance, but necessarily different in details of construction for incandescent circuits.

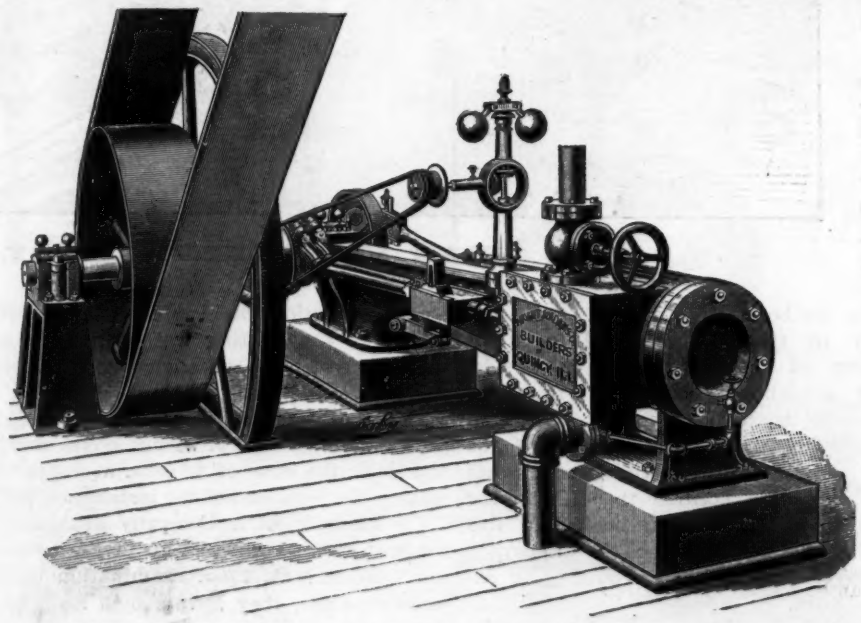
A New Automatic Engine for Electric Lighting.

The economy of automatic engines has made them a necessity in manufactures where fuel forms an important item. This necessity has stimulated engine builders, and there have been wonderful improvements made in this direction within the past 20 years, so that it is but seldom now that a plain slide-valve engine is employed. Among the Western engines designed for close regulation is that of the Wright & Adams Co., of Quincy, Ill. The engine, illustrated in the accompanying engraving, is so constructed that the two essential parts are embodied in two solid castings, viz: The cylinder and steam chest in one, and the frame, pillow block and cylinder head in the other; thus making the whole supporting parts of the engine with but one joint.

The cross head and guides are of the locomotive pattern, and are firmly set in position on the frame and have ample bearings. The packing of the piston head is self-adjusting, keeps perfectly tight and has but little friction. The piston rod, crank pin and valve rods are made of steel, and the main shaft and all other reciprocating parts of the best hammered iron; and all the journals and wearing parts are lined with anti-friction metal.

The valve is of the regular slide valve order, being moved on its seat by an eccentric on the main shaft with direct connection. The cut-off valve is also a slide valve used in connection with the governor gear, but differs from others in that the governor is not required to hold or drive the cut-off valve, but only indicates the required point of cut-off. By this means a much finer degree of sensibility is obtained, and consequently the action approaches much nearer to being instantaneous.

The stem of the governor acts upon the short arm of a lever attached to the outside of the frame. At the extremity of the longer arm is placed a V-shaped regulator, which moves forward and backward on a small roller. The effects of the variations of the load are felt by the engine, first at the shaft, causing an increased or diminished speed, which simultaneously affects the speed of the governor, and thus indicates to the regulator and directs the required motion of the cut-off valve. As the governor influences the lever, the regulator is caused to move upward and downward; as it moves upward it lengthens and downward it shortens the action of the cut-off valve, and thus indicates its point of cut-off.



NEW AUTOMATIC ENGINE FOR ELECTRIC LIGHTING.

It will be seen that the weight of the regulator acts continuously counter to the pressure of the governor on the lever, and produces, in the lever seeking its equilibrium, a fine degree of sensibili y.

The engine is simple in construction and can be taken care of by an engineer of ordinary intelligence.

New Hampshire Railroads.—The State Commissioners, in their annual report, say: "The car of the future will be heated by steam and lighted by electricity or gas made outside, and neither the conservatism nor the economy of railroad managers must be permitted to stand in the way of its speedy adoption."

Electric Welding in 1862.

To the Editor of The Electrical World:

Sir: As the subject of electric welding has recently been brought to the notice of the public again in connection with improved apparatus, it may be of interest to your readers to know that electric welding was patented at least twenty-five years ago, as will be seen from the following extract from an old patent specification. In the English patent of 1862, No. 1,516, granted to Morris, Weare and Monckton, page 3, line 36 of the provisional specification, the inventors make the following interesting statement: "For jewelry and other purposes we propose to fuse together by electricity the joints or ends of various metals, instead of using the ordinary processes, as a substitute for jewelers' and other solder, and also to fuse those solders where it is necessary to use them, whether soft or hard."

In the same patent the inventors claim the use of an induction coil for this purpose, but they do not state clearly whether they use it to convert high into low tension currents, or the reverse, though the former might be inferred.

In view of this old reference, how is it possible for the U. S. Patent Office to allow such a broad claim for the "art" of electric welding as that contained in patent No. 347,140 of August 10, 1886, to Elihu Thomson, claim 1? There appears to be something wrong somewhere, and it certainly is not in the reference. Does not this reference make this claim void, and make the art of electric welding public property?

Carl Hering.

Philadelphia, Pa.

A Problem in Electricity.

To the Editor of The Electrical World:

Sir: The problem proposed by "H. M. E." is easily solved in the following manner:

Let D be the deflection of the pointer in millimetres, E the E. M. F. of battery and r the resistance of the wire above the mercury. Then for any position of the beam:

$$D = \text{current} = \frac{E}{1+r};$$

where the resistance of the battery is equal to 1. Since the length of r is equal to D and 1 millimetre movement down of the pointer is equivalent to adding 1 ohm to the circuit, r may be substituted for D, and the equation reads,

$$r = \frac{E}{1+r}; \text{ or } r^2 + r = E.$$

Completing the square and solving we have:

$$r = \sqrt{E + \tfrac{1}{4}} - \tfrac{1}{2}.$$

In the example cited $E = 5$ volts, whence $r = 1.79129$ millimetre. The consequences of equivalent actions are employed here instead of equivalences, but the result is accurate and is reached much sooner than by analysis.

Lynn, Mass. C. McS.

[We have received similar correct replies to the same problem from the following: T. Wolcott, Brooklyn; J. W. Lattig, Mauch Chunk, Pa.; M. M. Garver, Philadelphia, Pa.; to which must be added that of G. B. P., Jr., in our last issue.—Eds. E. W.]

The Predetermination of the Characteristics of Dynamos.

To the Editor of The Electrical World:

Sir: In The Electrical World of March 5 "F. S." works out the formula $E_a = 2 Z_1 n N t 10^{-8}$ for the electromotive force of a dynamo—*i. e.*, just double that obtained by Mr. Gisbert Kapp—and inquires where the fault in his calculation is. There is no fault in his calculation, but in the assumption that $N t$, the total number of turns of wire in the whole armature, are in series.

The fact is that the two halves of a Gramme or other continuous current armature are in multiple arc, which would, of course, cause the figure 2 in the given equation.

In regard to Mr. Stephen D. Field's article on "Cross-

Fire on Electrical Circuits," it seems to me that the electro-kinetic momentum of the circuit is such a force as that of which he assumes the existence. The electro-kinetic momentum of a circuit is made up of the product of its own current into its coefficient of self-induction, together with the sum of the products of the currents in the other circuits, each into the coefficient of mutual induction of the given circuit and that other circuit, (Maxwell, Art. 579).

TOWNSEND WOLCOTT.

BROOKLYN, N. Y.

[C. S., of Easton, Pa., has given the same explanation of the error of F. S. regarding the formula of Kapp.—EDS. E. W.]

The Air Space in the Dynamo.

To the Editor of The Electrical World:

SIR: In the current number of your paper you ask for suggestions as to a name for the inter-space between the magnets and the core of the armature of a dynamo machine. Why would not the word "Annulus" be a suitable name?

CLARENCE E. WOODMAN, Ph. D.

Improved Testing Apparatus.

At the recent meeting of the National Electric Light Association held at Philadelphia, Mr. C. C. Haskins, of Chicago, called attention in a very forcible manner to the necessity of high insulation for arc, incandescent and power circuits. A new circuit, carefully and properly erected of good material, will possess an insulation resistance to satisfy the most exacting insurance or electric light inspector; but to keep this resistance up to standard after months of use, naturally requires close attention and frequent testing of the circuits. Our illustration shows a very convenient form of Wheatstone bridge and galvanometer combined, which, with 20 or 24 cells chloride of silver battery, leaves practically nothing to be desired for testing purposes. Measurements ranging from .01 ohm to over 1 megohm, can be taken quickly and accurately.

The illustration shows two pair of binding posts. One pair is connected with the two poles of the testing battery, while the other pair receives the ends of the circuit to be tested; or when testing for insulation, one end of the circuit only is connected with one binding post, while the other post is connected to a good ground, such as a gas or water pipe. The plugs of the rheostat are then placed so that on depressing the galvanometer and battery keys no deflection of the galvanometer needle takes place; when the resistance in ohm may be read off without any calculation, excepting, of course, the multiplication by 10, 100 or 1,000, according to the manner in which the plugs are placed in the "bridge" part of the instrument.

The oftener these measurements are made the better, and any defects or fall of insulation can be at once detected and remedied, and if a record be kept, it will, to quote Mr. Haskins, "contribute more hard facts to ward off an unjust accusation than could be shown by your president and board of directors in one long weary day."

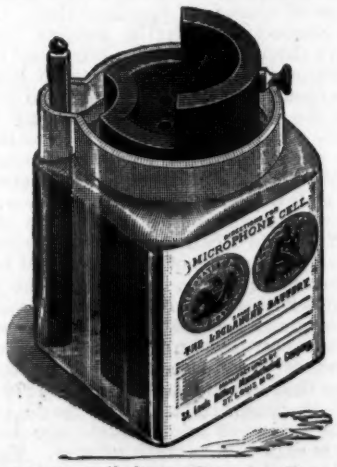
The Electrical Supply Company, 171 Randolph street, Chicago, manufacture these instruments and keep in stock two sizes, one to measure up to 11,100 ohms and a larger size to measure to 1 megohm and over.

A Headlight Hanger.

One of the notable features of American inland navigation, especially on Western and Southern rivers, is the great use made by the steamers of electric headlights. Their use does much to facilitate the passage of shallow or turbulent waters, and reasonably fills the traveler with a sense of greater security than he experienced under the old conditions. Various ingenious methods have been

HEADLIGHT HANGER.

hit upon for running such headlights, and some of the devices for obtaining the best effects are highly ingenious. We illustrate on this page a hanger, for example, that has been found of great service lately in this class of work. It is made by the Globe Iron and Electric Engineering Works, of Chicago. It is specially adapted for river navigation, and is under the control of the pilot, who can, with one hand, direct and focus the rays of light in any direction, up or down, right or left, with perfect ease and precision. It is easily hung and will not get out of repair.



"MICROPHONE" OPEN-CIRCUIT BATTERY.

The "Microphone" Open Circuit Battery.

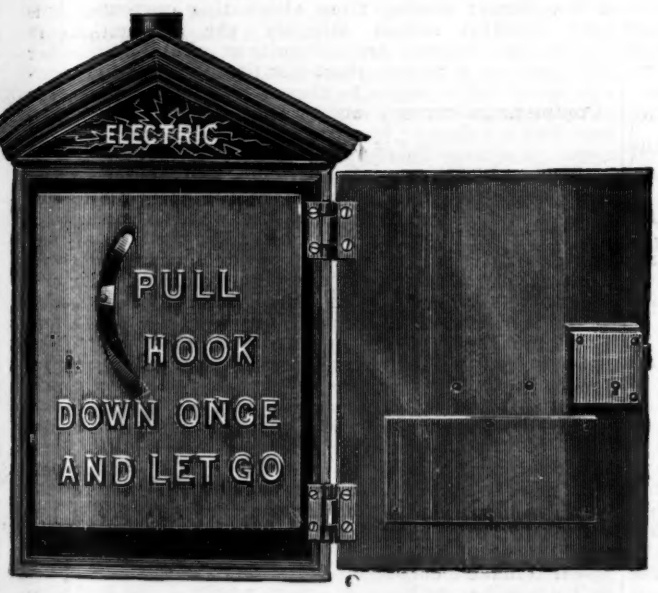
This is the name given to a novel form of the sal-ammoniac battery recently brought out by the St. Louis Battery Manufacturing Company, of St. Louis, Mo., and illustrated in the accompanying engraving. The negative electrode consists of a porous compressed carbon cup, in which the depolarizing mixture is placed. In this way the usual porous cup is dispensed with, and its resistance is eliminated from the battery. We understand that the battery is meeting with very good success in telephone, burglar alarm, annunciator and gas-lighting work.

A New Hotel Annunciator.

We illustrate on this page a new hotel annunciator, made by Hazazer & Stanley, of this city, for E. P. Eadson, Atlantic City, N. J. The chief novel feature of this apparatus is that all the works are attached to a separate frame, and can readily be removed from the case. All the wires being connected to the backboard, the case may be taken down from the wall and the works removed without having to disconnect any of the wires. It has a single-spool magnet gravity drop, with balanced armature.

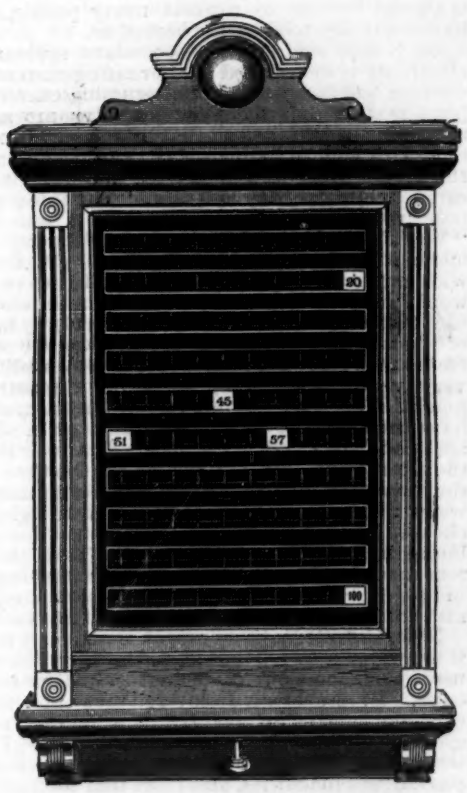
New Fire Alarm Box.

The accompanying illustration represents a fire alarm box recently designed by the Railway Telegraph Supply Co., of Chicago. With the system employed in connection with the box, a break or ground in the line on either side of the box does not interfere with the signals which come into the station. It is only when two breaks or grounds occur on opposite sides of a box that the signals fail. Such an occurrence is rare, and cannot, of course, be prevented in any system. The recording register is used in connection with the system, and a gong is sounded by a vibrating hammer operated by a local circuit. An electro-mechanical gong may, however, be employed, which gives a single stroke for each signal.



NEW FIRE ALARM BOX.

IMPROVED TESTING APPARATUS.



NEW HOTEL ANNUNCIATOR.

Newark, N. J.—The Edison United Manufacturing Company have sold a 300-light plant to E. Balbach & Sons, Newark, N. J.

Subway Affairs.—The new subway legislation for this city is still under consideration at Albany, the Legislature having taken no decisive step yet in the matter. A hearing of argument was had on March 22.

New Books Received.—Among the new books received at this office are: *Lives of the Electricians Tyndall, Wheatstone and Morse; A Century of Electricity;* and *The Arithmetic of Electrical Measurements.*

French Cable Matters.—A special dispatch of March 21 from New Haven says: As a result of the misunderstanding between the Western Union Telegraph Company and the French Cable Company, a gang of linemen employed by the latter are now going over the route of the American Union lines (now part of the Western Union system), between New York and Boston, cutting two of those wires at every place were they have been run into the Western Union offices. The French Cable Company has opened test offices along the route and will, it is understood, soon arrange to compete with the Western Union for the local cable business. Representatives of the Western Union are watching the French Cable Company's men, and at every place where the wires are cut they enter a protest, but do not interfere. The matter will evidently be brought into court. The trouble between the companies grew out of the French Company's withdrawal from the cable pool. The French Cable Company claims two wires from New York to its Cape Cod office, and are now taking forcible possession by cutting those wires wherever they run into a Western Union office.

The Distribution of Electricity by Secondary Generators.

The monthly meeting of the American Institute of Electrical Engineers was held at Cable's Restaurant, March 15, and after dinner the President, Mr. Frank L. Pope, opened the discussion of the topic of the evening, as above.

The PRESIDENT: The subject for discussion this evening is the distribution of electricity by secondary generators. As you all know, this matter of distribution of electricity for lighting by induction apparatus, variously called secondary generators, transformers, converters, etc., is attracting a great deal of attention at the present time, although it is not a particularly new thing, having been in operation in one form or another pretty constantly since the early part of 1883; and yet it is only quite recently that it has been brought into what may be called a commercial shape.

Very many of you are doubtless aware that something over two years ago I was commissioned by Mr. Westinghouse, of Pittsburgh, now the president of the Westinghouse Electric Company, to go over to Europe and make an examination of this system and to purchase some of the leading patents on it for use in this country. Mr. Westinghouse had already made some experiments with it, and had become interested in it. So I went over to London in January, 1886, and I had the pleasure of seeing there an installation of some 2,500 lights working on the Gaulard & Gibbs system, which at that time was the only important installation that had been made. I saw there were great possibilities in the system, although it was not worked out practically at all—not worked out as we would work it out in this country by any means—and I was so well satisfied with the results that had been already attained, and of the possible results which we could get when we put our young men on it in this country, that I closed the purchase of the Gaulard & Gibbs patents for America and brought them with me. Up to that time the matter does not seem to have attracted very much attention in this country, but during the past year a great deal of work has been done, and it seems now to have a great future before it. Theoretically, it is a system of the utmost interest. There are a great many novel points in it—novel in the sense that they have not been worked out practically. The action of the induction coil is a great mystery to a great many people, and not any too well understood by the best of us.

Dr. MOSES said: In the secondary system at present, electricity is distributed in alternating currents. The production and distribution of alternating currents is so simple a matter that the very first dynamo machine ever made was constructed on that principle. I recollect when Comte du Moncel told me of the consternation with which the people who were interested in the Alliance machine came to him one day and said, "The thing won't decompose water," for which purpose it was being made. "Well," he said, "I don't see any other way to do than to make it decompose water by turning it into a machine with currents of one direction, but if it were my affair I would leave it an alternating machine. Why not use the current at once for making light, instead of decomposing water with it in order to get light from the recomposition of its elements?" It was a very unfortunate thing that the alternating current machine did not decompose water, because we would have been about twenty years further in advance in the application of electrical science. That was the quietus of the alternating current machine for the time being. Well, they made a continuous current machine that decomposed water; but soon found they could make light a great deal cheaper by that alternating current machine than by combining hydrogen and oxygen. The first alternating current machine they made I have seen working near Havre in the light-house. It has never been stopped but once, and that was in order to put in a pillow block.

Now, the alternating current machine is so simple that it is a wonder to me that it did not continue in general use. But then there came another matter to give it a setback. M. Archereau discovered that a solenoid was a very excellent means of regulating a lamp. You could not use the alternating current with that. Therefore the whole stream of invention ran into the channel of continuous current machines, and from that moment continuous current machines were universally studied because they could operate the regulating device of the ordinary solenoid arc lamp, and as the arc light business was the great one by which electricity was going to be built up as the power for general use, practical continuous current machines were invented and generally adopted. When a thing once gets on the ways, sliding down like a ten thousand ton ship, you cannot stop it. The invention of the Jablochkoff candle gave another stimulus to the alternating current machine, but popular prejudice excited by the death of a careless sailor on a Russian royal yacht, caused its almost total abandonment for use in electric lighting, and finally the introduction of incandescent lighting on a great scale on continuous current circuits made it disappear entirely from use. But now the alternating current machine has taken a new and grand departure, because we find that you can only distribute currents by secondary generators where they are alternating in their character. Therefore, the alternating current machine has to be introduced, and its great advantages, which were hidden simply because they were not needed in the beginning, have come to the front, and it will be adapted to all kinds of distribution of electrical power. That sounds like a pretty broad statement when we know that motors are to be run on continuous current circuits. But what is the difficulty if you have got an alternating current machine that sends its current to and fro? Why, usually you send it to and fro through the same point. You can send it *to* there; and you can send it *fro* here, and you can have all the continuous current you please on the one side and all the continuous current you please on the other side. (Applause.) So that an alternating current machine can be made a continuous current one, and you can adopt the alternating current machine to any of the uses to which a continuous current machine is now applied. To come to the point, I would say that the practical application of this thing has been demonstrated to my satisfaction, and that is something that means to me a good deal. I think that alternating currents used from secondary generators are going to drive all the small electric appliances for the distribution of power that are now used. Secondary generation is bringing about a change that is going to result finally in a commercial revolution. We will find currents distributed abroad in every direction, in every house, and we will have power at command for all purposes, just as we have it here at this moment in the incandescent lights around us; and that is all going to come about through this alternating distribution.

Dr. MOSES then referred to his visit to Pittsburgh where he had seen the system in practical operation. He spoke also of the similar station in Milan, Italy; he also quoted the opinion of Prof. Colombo regarding the high efficiency of the secondary generator system.

Capt. MICHAELIS then gave an account of his visit to Greensburgh, Pa., where alternating currents are distributed and transformers used. He found a prosperous and paying station distributing about 650 lights.

Prof. ELIHU THOMSON: The subject for discussion this evening is one of very great and growing importance. I am forced to recall a little experiment I made in illustration of the reversibility of an induction coil, before the Franklin Institute of Philadelphia in 1877. I then gave a course of lectures on electricity and the main principle put forth was that electricity of all kinds and characters—statical, dynamical or whatever you choose to name it,—was really the same thing and of exactly the same nature, differing only in potential, pressure or electromotive force and volume. I exhibited, of course, in illustration of this, Ruhmkorff's coil, and while preparing the lecture it struck me that it would be a very pretty experiment if I could reverse the process, and instead of getting discharges which would have the statical properties, I should take my Leyden jars and put the Leyden jar discharge through the fine wire of the Ruhmkorff and see what I would get in the primary circuit. This I did, and I was somewhat astonished at the volume of current which seemed to come out of the primary. I expected, of course, to get a heavy current. I knew perfectly well that the Ruhmkorff coil must be reversible, but I was surprised to see the energy that the Leyden jar discharge displayed when it was turned into what was then called the quantity current; the ends of the primary wire being brought together, there was a bright green flash, and after repeating the experiment once or twice the wires actually stuck firmly together. It was with difficulty that I separated them. They bent a little, and with a good pull they separated. There was a sufficient proof of the reversibility of the induction coil. The capacity of the Leyden jars was three gallons. The spark which fused the coil was an inch and a quarter long. Another fact came out in the experiment which was very striking. We are all familiar with the loud snap produced by the Leyden jar discharge and the bright flash. I was surprised to see, however, that the spark which struck through the coil was exactly like the Ruhmkorff spark. It occupied a time. It did not go with that sudden energy with which the Leyden jar discharged, but it went through with the appearance of the ordinary Ruhmkorff spark. This thinning out was no doubt due to the retardation which occurred in that discharge. This experiment was repeated, and the primary wire was also connected with a galvanometer of very coarse wire, and the needle went right up solidly to the stop at every Leyden jar discharge. At that time I thought it must be perfectly well known to anybody that would dwell upon the conditions.

This experiment left its impression on my mind, and my recent experiments in welding by electricity are really the outgrowth, as I see it, of that little experiment of the Leyden jar discharge sent through the Ruhmkorff coil. When engaged in electric lighting, I found it necessary in the construction of dynamos to make good joints on wire, and it was with some difficulty that really good joints were made. Our wire in the early days was only obtainable in about fifty-pound lengths of copper and some of our coils required about 300 pounds, so that we had to make some five to six joints in every coil. In thinking the matter over, it struck me that electricity would do that work, but the thing was to get the currents. They were necessarily enormous. They were necessarily much larger than we had been accustomed to deal with. Arc light currents and incandescent currents in those days probably did not in any case give more than two or three hundred or four or five hundred ampères. The induction coil experiment, however, seemed to point out the way, and I designed at that time an apparatus which I thought would answer the purpose, but I was compelled to lay the business away and had no time to develop it further. Taking it up, finally, however, I tried the experiment of building a small alternating machine and putting it on to a moderately fine wire, which was to be the primary, and taking a very coarse and heavy secondary, so that the potential of the currents generated in the secondary might not exceed one or two volts at the most, but could run up to thousands of ampères. The first experiments made with the apparatus were entirely successful in joining copper, iron, steel, etc., the wires being a moderate size of course. I mention these facts simply to show their connection with the subject under discussion. We have there probably the extremest case of what we call conversion from high potential to low potential. Dr. Moses has mentioned the fact that no commutators are needed on the alternator, and I can say that it was really fortunate for us in welding operations that there are none, because our currents are varied enormously in a very short time. We start out with a piece of metal that probably is only a few square mils in section, and with the same apparatus we run up to an inch or more in diameter, and if we had a commutator on the machine that amounted to anything, we, of course, would have to make a new adjustment each time, and every time the current changed greatly it would be likely to tear out the metal and throw it around, because we run under strong conditions while we are putting on the heaviest current. As to the distribution of incandescent lights by the induction coil, I may say that in the latter part of 1878 and 1879, in company with Professor Houston, I made some experiments with the design of using a little arc lamp for distribution. It is called a vibrating lamp. The electrodes were vibrated to and from each other, and we used induction coils to give the impulses to vibrate the carbons and also to supply the currents to the little lamps. The incandescent lamp in those days was unknown. There was no such thing as an incandescent lamp in 1878, at the time the experiment was made, but gradually the incandescent lamp became known and induction began to attract some notice in regard to distribution. Now, it always has appeared to me that there never could be any doubts as to the efficiency of a good induction coil; that is, that the losses in an induction coil never could amount to a great deal if it were properly made. What is a dynamo machine but an induction coil after all? It is a revolving induction coil. We have what might be called the primary circuit in the field magnets in the magnetism, but instead of reversing the current in the field magnets we reverse the position of the secondary; that is, we turn it over to get our impulse; that is, not where those impulses come out as gushes of current or waves, but if we turn over a portion of the armature by degrees we get a continuous flow of current and if the dynamo can be made to go to an efficiency of 90 per cent., why cannot an induction coil be made to go to an efficiency of 95 per cent? We use a reverse primary. We do not reverse the position of our armature in relation to the magnetic field developed by the field magnets, but we make our field magnets reverse and divide them up by laminations or by making them of fine iron wire. Put plenty of iron in the coil and the losses should not be any more in making the conversion, so far as Foucault currents or local currents in the iron are concerned, than they are in a well constructed laminated armature. In regard to the use of alternating currents, let us see if there is any possible objection to the use of them. There has been a great prejudice against alternating currents, which I think has gradually been removed on account of the very fact that they alternate and that they are without the danger of severe shocks. We have learned to look upon alternating currents, somehow, with considerable dread, on account of the fact that the current goes this way and that.

Prof. THOMSON then detailed how he had accidentally taken the alternating current of many thousand volts from an induction coil operating a Jablochkoff kaolin lamp, and without serious consequences. He continued:

The other day, in experimenting with alternating currents in which the maximum difference of potential existing was about 1,300 volts, capable of equaling in potential a good circuit of arc lamps, I happened to touch a post and to bring my hand to another post, and I felt something or other queer and drew away. The result was I got a little blister on the hand, but that was all. If I had short-circuited an arc current of the same power, I would not have got away so easily. I should have come away with my hand very badly burned. But, as it was, the alternating current did not follow just as I ruptured the contact. That is a feature of the alternating currents which is very good in rendering them safe. Let us see if we can find any reason for it. The alternating currents rise and they come down and they reverse and so on; but there is a line along the middle of the curve which is neutral. Now, unless the materials are of very high volatility, the spark formed is very apt to be extinguished on that reversing point. At the same time there is another fact which would cause that arc to be extinguished, and that is the effects of self-induction or extra currents in prolonging the discharge are nothing. Take an alternating current, and if it changes you can follow up anything that has short-circuited the apparatus. It would seem from these experiences that we need not have any great fear of the danger arising from alternating currents. It is very doubtful indeed whether the fluctuations in the arc light current are not quite as great, and whether the injury to a person short-circuiting an arc light current is not due as much to abrupt changes in the current as to the mere current itself. That is, an arc light current does not usually have the character of even a wave—a smooth wave. There are segments in the commutator acting just like so many break-pieces, and whatever effect they produce is produced in an inconceivably short space of time, and if we could map the wave so produced it would be very irregular and jerky. No doubt every one has tried the effect of a shock from a magneto-electric field. Every one knows that if the field is regular and the contacts are good he can stand a pretty fair shock; but let it be irregular, let some faulty condition occur, and give him a shock and then ease up a little and give him some more, and it will be found to very exhausting indeed. In the one case he knows what to expect and is prepared for it; in the other he is not.

This brings us up to the consideration of the nature of the alternating current itself. It is a rhythmic wave, and it can be made just as perfect and as smooth, so that at any portion of the wave the change of current is quite slight. There is not a sudden jump of current or a sudden action, which, though it occupy only the ten thousandth part of a second will make a considerable difference in the wave. Let us see whether we have any facts which would lead us to think that there is a difference of that kind between the ordinary arc light and the alternating current. In working on this alternating current matter, it occured to us there might be some difficulty in running lines on account of telephone interference. Injunctions might be served on anybody running lines if the alternating currents had a bad effect on the telephone lines. To test that matter we ran parallel lines to the arc light circuit, using about the same current on each, and I was surprised at the results.

Prof. Thomson then described some experiments which showed that the effect on telephone wires of the alternating current was far less than that of the continuous current. The strongest effect produced by the alternating current was a musical note in the telephone, which did not seriously interfere with ease of communication; whereas, the continuous current gave a rattling and scraping sound.

Mr. WETZLER: It occurs to me that the point of utilizing a high potential current of low quantity for the purpose of facilitating distribution is one which can be looked upon in another light; that is to say, we may use a continuous current and interrupt it. That system has been brought out recently, and, it seems to me, presents some quite interesting points. The arc current to day may be considered in that light. We have there the conditions of a high potential circuit with low quantity. Why may we not by suitable apparatus break that current at certain points, utilize it to put our secondary generators in operation and then continue it on; or, if you will, break it directly at a central station and use the broken continuous current (if you might so call it) in the same way as you would the alternating current? We have all heard of the advantages and also of some disadvantages of the secondary generator system in this country as presented here. I think it may interest the members to hear the opinions of some foreign electricians on this subject. Dr. Moses has given us Prof. Colombo's opinion on that, which is very favorable, and I think, for the sake of discussion, that some of the unfavorable opinions might be brought forward. In a pamphlet recently issued by them, Siemens and Halske, of Berlin, flatly contradict the utility of the secondary generator system. They say in effect that isolated installations, even large ones, may be practicable on this system, as witness some of the installations already existing in Europe.

These they consider, however, only isolated systems, though on a large scale. For a general distribution they claim that the thing is not feasible, in fact, is not as good as the ordinary two-wire direct distribution. I must say this, however, that they premise that all distribution must be done by underground conductors. They say that if you want to distribute generally, an overhead system is out of the question; that there are too many uncertainties in connection with it and that you must go underground. Now they figure up that to put underground a high potential system in which, instead of using 100 volts ordinarily, you use two thousand volts, with a corresponding reduction in copper, the money you save and interest on that copper will not make a difference of one per cent. in your expense account. That is to say, that in the largest underground cables, properly insulated, the value of the copper contained in them does not exceed 15 per cent. of their cost, and in smaller cables this ratio is even less. To this must be added the fact that the transformers necessary constitute an item which, together with the above, almost balances the saving in copper obtained by using high potentials. Then they bring out the argument against the alternating current, that it is not available for motors, which they consider a valuable adjunct for electrical distribution. How far these objections are good in an overhead system, or how far they can be removed, remains to be seen. I think they can be removed, if they are not removed already. But such is the opinion of

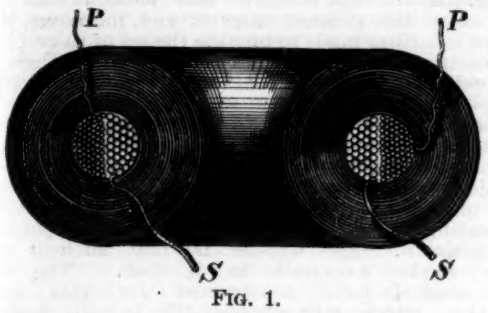


FIG. 1.

Siemens and Halske, which has some weight, whatever their motives may be, and they deprecate the secondary generator system, for the reason that they say it is not suited for general distribution, which must be effected by underground wires. They also say that you cannot regulate the secondary generator within the limits that must be obtained to give satisfactory incandescent lighting. They say that if a secondary generator will only regulate within 4 per cent. when turning on all the light, that that is not sufficient, and that secondary generators cannot regulate closer than 4 per cent. I believe that that objection can be removed if it exists.

The PRESIDENT: I would say in respect to one point raised by Mr. Siemens, that it is not quite clear to me, since a secondary generator is nothing more than a dynamo, why it is not possible to regulate with a generator as it is with the direct distribution.

Mr. WETZLER: Siemens and Halske, in their pamphlet, criticise other systems, but they say that they have got something of their own that will answer.

Mr. C. O. MAILLOUX referred to the analogy of action in the dynamo and the induction coil, and said that theory would show that the latter ought to be a more efficient device, as it had practically no dead wire, and that hence the electromotive force developed per unit length of wire ought to be greater. He inquired if any experiments had been made on that point. He also referred to the fact that the transformer was liable to acquire a static charge which might discharge itself through a person coming in contact with the transformer.

Prof. THOMSON: I will say that in regard to the effi-

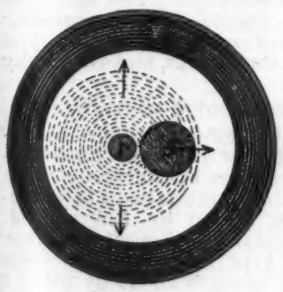


FIG. 2.

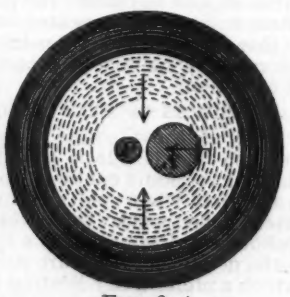


FIG. 2 *A*.

ciency of the wire of the induction coil that it is certainly possible to produce a higher electromotive force in a wire subject to induction than it is possible to produce in a dynamo armature. The reason, however, may not be the same. It is practically a greater speed that does the work; that is, the alternation may be made at various rates; we can have 10,000 alternations per minute or we can have 15,000 or 20,000, and it would naturally result that if the field of the induction coil should be changed 20,000 times and to the same degree, that at that rate of alternation a certain length of wire in the secondary should give out twice the electromotive force that it does when subjected to 10,000; and also that the primary wire should kick back, as we may term it, with a double kick, or, in other words, be able to hold back an electromotive force twice as great.

The question arises: Is that secondary wire *S* (Fig. 1) in the magnetic field? It is not; that is a certain fact. The magnetic field is around it and does not show any polarity whatever and the secondary wire is not in the field; but the secondary wire was in the field at the moment that the magnetization was going on. Consequently, the secondary wire gives out a current when the primary wire *P* is beginning to take the current up to the maximum which it may reach. To make that plain, we will separate the wires a little. We will call it a single wire. That will be the primary *P* (Fig. 2); this the secondary *S*. Now, what will be the effect if we pass a current through this wire *P*? It will cause circular magnetism around it, and that circular magnetism will emanate in all directions quickly, and stop when it reaches the best medium; that is, when it gets into the iron. That is my view of the action. I do not know that it has been adopted at all, but I look at it in that way, that the wire conveying a current gives out, as it were, shells of magnetism rapidly expanding to large dimensions. But, if it meets with such a good atmosphere as iron, those condense themselves in the iron.

What does the secondary do? If it has an open circuit it does nothing. If it has a closed circuit it develops a current. I say when it has an open circuit it does nothing; I am not strictly correct there. It develops only an electromotive force in the two ends of the secondary, which, if it gets a circuit to produce a current over, will produce that current. But the very fact of the passage of the current in the secondary tends to produce just the opposite magnetization, Fig. 2 *A;* that is, as these lines pass across, the secondary would pass them by producing a field of its

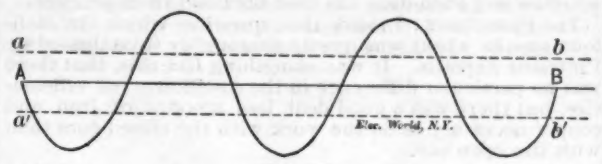


FIG. 3.

own. But if the primary is much the stronger, then the secondary has not got any chance to have any field of its own, and it kicks all the harder for that reason; that is, it gives out more current just because it cannot have its own way.

As to the actual practice in regard to the length of wire I must, before stating what I know to be the case in regard to such action, see what we have in the alternating current. What have we? We have an increasing current from zero up to maximum. (Fig. 3.) And following the current down to the zero and opposite, flowing up to a similar maximum, and so on through. What volts shall we give to that current? Shall it be the distance between the top and bottom of the wave, or shall it be the average of positions on the wave *a a'*? Now, it is evident that in running an incandescent lamp it is not this electromotive force (*a a'*) that is used. When you put a 75-volt lamp on such a current, you do not take that; it must be higher than 75 volts, because this electromotive force which would produce that current does not last all the time. It is probably nearer 150 volts. The maximum differences of electromotive force are probably nearer 150 volts, and we have a point here where there is not any difference. We then must take the average *a a'*, and that is the average volts. You see that gives us another view of the electromotive force developed in a coil. If that is the maximum difference, then this wire is developing more than it appears to develop per foot or per number of feet. Now, in actual experiments with alternations of very nearly 10,000, the number of inches to develop a volt by such an arrangement will be somewhere between six and twelve in the

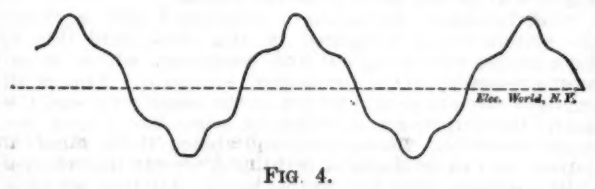


FIG. 4.

primary and secondary. But the singular part of it is—supposing we take the figure with nine inches with rather slow alternations—our nine inches develops a volt in either. What does that mean? Why, it means that four and a half inches develop a volt of maximum and minimum difference; that is, taking that point from the highest point in the wave to the opposite highest point, it is a good deal higher. Now, I cannot say just now that it would be exactly one or two; because that would depend upon the shape of the wave. Taking an extreme case it might be an irregular wave (Fig. 4) and the average of the electromotive force in that case would be lower than in the regular wave.

The point in regard to induction in telephones is also made clear by studying a moment the action that occurs. From that point to that *b b'* lies a certain change in the phase, and so all along. That kick is quite gradual, and if the diaphragm of the receiving instruments gets an induction which is gradual, it will not give a blow hard enough on the ear to be heard distinctly; but if that wave should be of the character of this (Fig. 5), then every one of these little jumps will cause the diaphragm to hit the air a blow, and that would be heard on the drum of the ear. In relation to the static charge, I do not attach as much importance to that as would at first seem might be attached to it, for the reason that the actual amount of condensing surface in the induction coil is not a very great amount after all. It is quite possible to take rapidly alternating discharges from a little magneto-electric machine which may represent far more current energy than the charge or discharge of a moderate sized induction coil, although it is possible that with induction coils working hundreds of lights there might be a stinging shock obtained by touching the wire of the induction coil. The

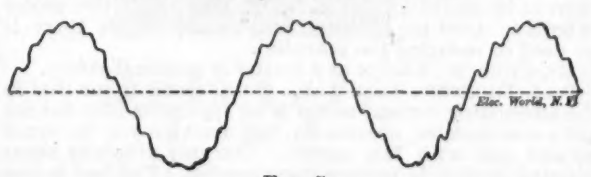


FIG. 5.

static charge does certainly exist, but it represents very little current, so that a person may take it without any inconvenience. A person standing on an insulated stool can have 10-inch sparks drawn from him and he does not mind it at all. He can charge his body through the potential of many thousands of volts, and he can discharge that potential from his knuckles without any other feeling than a little shock in the arm. I have taken by accident discharges from Leyden jars—say three gallon jars at an inch and a half of striking distance—and all that I felt was a violent shock which was over in a moment. It may benumb you a little, but it does not amount to anything.

As to another source of danger in the use of induction coils, such an accident as this may happen at any time. By moisture or by faulty construction or some other such cause the primary may become connected with the secondary or be so close to it as to cause a leak from one to the other. No particular danger should result from that alone, although there would be a more vigorous discharge, statical in character from such a connected secondary, because on the one side of the line you would have a rather long line, and at this one point you would be able to get the discharge of your whole line in rapid succession. But the chief danger in such a case is the formation of a second contact to ground. The induction coil, which at the same time had a contact to the primary line, would necessarily take the potential of that line, and we will suppose that is on the other side of the line. Now, a person may go to the lamp under those conditions and his fixture might be near a metal object, it might be connected by moisture; he might stand on the moist floor, and the result would be the current would come down through his body and he would be subjected to the full potential, and there is no doubt that if he should be foolish enough to stay there he would have to stay there until somebody took him away. A man when he is shocked generally drops away from the thing that shocks him; but he may be, as we term it, "hung up;" that is, he cannot let go, and that is undoubtedly the reason why accidents happen in arc light distribution. If a man can get away at once, even such a potential as 2,000 or 3,000 volts will not kill him, as we have had plenty of experience to prove. To avoid such dangers in alternating current lines we provide a very simple means, we ground our secondary. If the insulation between the primary and secondary is as

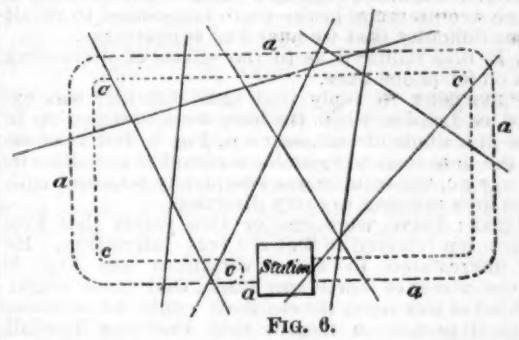


FIG. 6.

good as it ought to be at all times, the grounding of the secondary will not hurt anything, that is certain. What then occurs? If the man takes hold of the secondary wire and touches a radiator connected with the ground or a water pipe, he is already shunted by a good conductor and he cannot get anything to hurt him. Put this to your steam radiator or water pipe. That addition to the system would save us from all shocks, but it would introduce another element of irregularity and danger; that is, it would provoke contacts to the secondary line; but, nevertheless, if a contact does occur, cut your line off altogether by putting a fusible plug in the circuit leading to the primary, so that if there is any diversion of current through to the secondary and to ground, the plug will blow out. There is another danger, of course, in having this ground connection, and that is the danger of atmospheric discharges, lightning, etc. That, however, can be avoided by making the insulation here heavy, and in fact separating the wires by an air space, and then putting near the primary line where it enters the building, or in any convenient point, an ordinary lightning arrester, in which the spaces between the line and the conductor to ground are so small that an atmospheric discharge will seek the ground through that and not through this. Of course it would be necessary in running such a system to test it for grounds just as lines are tested to-day.

Mr. W. LEE CHURCH: My proper office here would naturally be to defend the secondary system against attack, but I find that there has been no serious objection raised. With reference to the opinion of Dr. Siemens, I have only to say this, that I should reply to his criticisms by subscribing my fair share toward paying his passage to this country to see the thing done. (Laughter.) I was re-

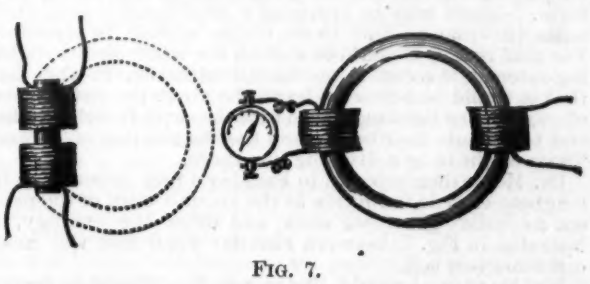


FIG. 7.

cently at Daly's Theatre and witnessed that charming production of Shakespeare's, "The Taming of the Shrew," and I noticed that *Petruchio* insisted that that was the sun, in defiance of the fact that the moon was shining; and it strikes me as ridiculous (if I may be allowed to couple that term in connection with so distinguished a man as Dr. Siemens) to state that the secondary converters will not govern within better than a range of 4 per cent., in defiance of the fact that the company with which I am associated is operating these converters commercially, deriving its pay from the plants, and the whole thing is reduced to an ordinary matter of fact. The variation is absolutely not appreciable by any of the instruments that we can bring to bear upon it outside of the laboratory. We are putting in 100 volts and taking out better than 98 in selling them to people and getting our pay for them. I contend that the final touchstone in the eye of the practical man, and more important in the eye of the man to whom we sell, is, Can I take this thing, disregarding the whyness, and simply secure the result and put it in my vest pocket? The question has been also raised as to whether the distribution upon this high potential system coupled with underground circuits might not be essentially as bad as on the ordinary multiple, and eat itself up in capital before going out to a certain distance. Let us look at it from the commercial standpoint. Copper is not the sole element of economy by any means. In fact, I think there has been an injustice done to the secondary system by insisting that its prime usefulness lay in the reduction of the first cost of primary wiring. That is one way to put it; I think it is the least forcible way. As I judge of it, from daily contact with it commercially, the usefulness of this system lies in simply extending your business from a given point to the remotest point possible. We have certain fixed expenses—I am now talking to you from the stand-

point of the man with whom I deal—these expenses consisting of salary accounts and investments in building and interest and depreciations and what not. Now I wish to thin out that expense as far as possible and to make it bring me in a large amount of business. Therefore, if it were true, which, permit me to state, it is not, that the increase of the cost of copper was in any such ratio as has been alluded to by Dr. Siemens, it still would leave untouched the fact of rendering the other fixed expenses of the installation available for the increase of business. That fact has been commercially proved with us beyond peradventure. The use of the generator system—high potential system—permits the running of wires on a very small percentage of drop of E. M. F. With the ordinary multiple arc system and low potential our copper is so much anyhow that we have got to sacrifice ten or fifteen per cent. of drop to secure a reasonable amount of copper at all. But this converter system enables us to run upon a two per-cent. loss in the primary coil, and that saving is a merchantable article in some form in any way you are of a mind to figure it up. Furthermore it has an enormous effect upon the light of the lamps, which is another commercial question. The secondary system enables you to maintain an almost absolutely uniform potential all over your line. Thus I might drift along, touching upon a host of points which are in no sense scientific and yet seem to me to carry much weight if we consider the question in its practical and every day aspect. I am pleased to say that so far as our work has progressed—and we are treating it entirely on a commercial basis—there has seemed to result no serious difficulty that we have had to overcome.

Mr. E. E. RICE inquired as to the effects of alternating currents on telephone lines.

The PRESIDENT in reply said that difficulty was experienced in London when the lines were first put up in the shape of a single circuit, as *a a a*, Fig. 6. But after arranging the lines so as to resemble a complete metallic circuit *a a a c c c*, the trouble was completely removed with telephone lines crossing in every direction.

Dr. MOSES: There were one or two points that Professor Thomson referred to that are very interesting. He says if intercalated in these variations (see Fig. 5) there were waves of small amplitude, that those might make a kind of tick upon the ear that would be audible. He will recall perhaps a remark that Professor Tyndall made when he was once going on one of his excursions with a guide. He said to the companion: "What a deafening sound that is that I hear." The man said, "I do not hear anything at all." Professor Tyndall looked at the man in amazement. "You do not hear that sound," he said. "No," said the man, "I hear nothing." Well, it was a question of fact, and Tyndall had tried to explain it, and did explain it very reasonably by saying that his ear was tuned a little higher than the ear of his companion, and that the grasshoppers who were producing this fearful noise and had collected in great swarms in his neighborhood—their note was of so high a pitch that his ear could hear it and his companion's could not. Now, if you calculate the variations that there would be in an ordinary alternating circuit it would amount to about 250 a second. 250 variations a second would make a very pleasant musical tone; but these small waves would be so small compared to the whole amplitude of the waves that they would be altogether inappreciable to the finest tuned ear. They would amount probably to 8,000 or 10,000 vibrations per second, which would be perfectly inaudible, so I doubt whether the rise and fall of the waves would produce that unpleasant sensation if it were only slightly interrupted. There is another point that I would like to call attention to with regard to what has been said. Mr. Church referred to running these wires overhead. I think that very serious consideration ought to be given there. While this underground commission is somewhat in confusion, a great deal of attention should be given to this fact, whether it is absolutely necessary for wires carrying alternating currents or currents of very high potential to go underground. I think there ought to be a distinction made. Although an alternating current may not injure a telephone, still it is not every current that is perfectly uniform. There may be breaks in it, and it might introduce some disturbance, and those things should be avoided. For that reason it would be well for the whole electric lighting interest, it seems to me, to call attention to the fact that it would be better to leave the air to the distribution of current for lighting and to take the earth for telegraphic and telephonic distribution and the distribution of power. There ought to be a dividing line there.

Dr. Moses then referred to Faraday's first experiment in magneto-electric induction as the ground work of the present secondary generator work, and drew the analogy, illustrated in Fig. 7, between Faraday's coil and the modern induction coil.

Mr. MARTIN: I would like to ask Mr. Wright in regard to the line distribution of these converters. My friend Duncan, in Pittsburgh, is very well pleased with his secondary generator plant there, and stated to the Philadelphia convention that he had some of his converters on the poles, but said that in one or two cases he did not think it necessary to have it there but attached it to the building.

Mr. WRIGHT: At present my converters are on the poles. My lighting is scattered, and I have not a large number of converters, but I have more than is sufficient for my capacity. They are sometimes about four or five poles apart, a great deal depending upon the disposition of the lighting. Of course I may have occasion to place my converters in the interiors of buildings in some cases, but generally outside the buildings. I propose in Plainfield, in the residence portion of the town, to run my branches from the sub mains into the central portions of the blocks. I forgot to mention that I am running in my station at 104 volts. My line is calculated in the business portion of the town for 1,500 lights. At present I am simply regulating by my station lights. I have had no trouble whatever with my armatures or converters.

Mr. MAILLOUX: I would like to have somebody tell me whether anything has been done to develop the application of the secondary transformers for distributing power in motors. Dr. Moses has told us that he could send one impulse *to* and the other *fro* in the same circuit. It would be interesting to know whether this to-and-fro matter is only theoretical, or whether it is practical and has been accomplished. I would also like to inquire whether in the event of a system of distribution by periodic impulses of one polarity on each circuit, the size of the transformer, and, to a certain extent, the method of its application, would not need to be changed to conform to the different manner in which the energy would be distributed, because we shall have now energy being supplied by the circuit for only half the time, and of the energy so supplied we must store enough in the induction coil to maintain the supply during the other half. In other words, it must produce a certain magnetic reaction which will be sufficient to keep up the energy during the remaining half.

I would also like to know what has been found in practice to be the difference in efficiency between the coils of the ordinary straight description and that of the circular form which is generally used in installations for distributing energy by means of transformers. I have had this question submitted to me lately on several occasions, and I was of the opinion that the difference in efficiency would not exceed two or three per cent. I would like to know whether any such data has been obtained from practice.

The PRESIDENT: I think that question which Mr. Mailloux speaks about was pretty thoroughly investigated by Professor Ferraris. It was something like this, that there was no particular difference in the co-efficient of efficiencies, but there was a good deal less amount of iron and copper necessary to do the work with the closed core than with the open one.

Mr. MANSFIELD: The subject of the distribution of electricity for lighting purposes has been pretty well handled by means of the converters; but I fail just exactly to see what use for motors the converter is. In the installation at Plainfield we have not such a great distance to annihilate, and all men who are engaged in the transmission of power are talking about annihilating space. Mr. Wright, I think, spoke of using the converter right in his own station. Now, I do not see that there would be any economy there over the direct system, unless when you go to a distance you want your alternating currents or your high potentials there, so as to annihilate the distance. You put your converters or transformers on so as to get the electromotive force down to a working basis, and with motors I presume that the same converters can be used. But I do not see just how the economy comes in in using the converters so near the station. In my opinion a station established with the ordinary arc light potential in the middle of New York City, exactly in the centre of the longitudinal axis of the island, would quite easily handle the motor problem in the entire city, and even at a less potential than they are using on some of the arc light circuits. The question of danger is another question. But I think that can be simply answered by the fewness of the lives lost on the arc lighting circuits. So that, after all, perhaps right in the arc light circuit we motor men have a means for carrying on our business without interpolating converters.

Mr. WRIGHT: The last speaker made a remark in regard to a converter in the station. I can hardly light my station without converters, seeing that I have a thousand volt machine and my lamps are 100 volts, worked at a distance. My lines in Plainfield, at present, average about five thousand feet from the station and I am laying out one line which will be four miles from the station.

Prof. THOMSON: In regard to induction I may say that the system which is figured on the blackboard (Fig. 6) has a double wire going out and returning, which is almost a necessity in the running of our plant. Almost all arc light circuits go and return on the same pole and the nearer the outgoing and returning wires are placed the better it will be. But as we cannot place them close together, we can do the next best thing, we can interchange their positions, cross and recross back. All that we have to do is to produce such a condition in the wirings as will not give an effective magnetic field which can act on the other wires.

With the alternating current machine you can turn up and down a lamp without a loss of energy amounting to anything. Now that seems a surprising fact, but it is true. The lamp may be run just as you would a gas-burner; turn it down so that the filament is red, by a little attachment no bigger than my fist. It is simply the interposition of a very little coil—not an induction coil—sheathed in iron and with the capability of putting more or less wire into the circuit; in other words, setting up a good electromotive force in the circuit will prevent the current going through the lamp, and will do that, not as a resistance in the lamp, but by throwing the electromotive force back on itself. That can be done to a single lamp or it can be done to a group of lamps.

On the continuous current circuit there has been, and is, a continual strain after high volt lamps. It is almost regarded as impractical to run any distance unless you take one hundred or one hundred and ten volt lamps, the highest that can be commercially made. The reason is that when you get beyond that the filament will almost sag by its own weight, and the one hundred volt lamps that are made to-day are generally of a low efficiency, compared to lamps of lower volts which will give exactly the same life. A fifty volt lamp, for example, can be made to use less energy than a one hundred volt lamp, and give the same light.

As to the motor question I think that the alternating current motors can be made to run nearly as efficiently as continuous current motors, and with the saving of drop in the mains we can afford to run them less efficiently. It is not absolutely necessary to change the high potential current by an induction coil for the motor. If the motor is built to stand the potential in the main circuit there is no need of reducing the potential.

Mr. CHURCH: Except as a matter of personal safety.

Prof. THOMSON: That is all. But it seems to me that as the alternating current motor is an apparatus that has not got a commutator, necessarily, the machine may be boxed up and run with fair safety. The only difficulty about running motors is getting them started. The fact is that if the impulse comes at a certain rate, unless the motor takes that impulse at the same rate, it will not start; that is, you must give it the speed first; you must put it in tune with the rest of the circuit by giving it the speed; then clap on the current and it will run at that speed absolutely. If you overload it you will draw it down and it will stop. Now I have in my possession a little machine which, put on an alternating current circuit, will start from the state of rest and run right up developing considerable power. That machine may not be as efficient as the continuous current motor; but I can put that little motor on the same shaft with the larger motor and give it the speed of that little motor. I thus have the whole thing under my control. I take off the load from the motor and I put this little motor on and I put the larger motor off and then throw the current on and throw off the other. I am not at liberty to describe in full that arrangement. As yet it is not fully developed, but I hope before long to have it in such a shape that it can be fully discussed.

Telephonic Investigations *

BY PROF. SILVANUS P. THOMPSON, D.SC.

(*Continued from page* 147.)

Not being quite satisfied with any of the instruments which I have now described, though any one of them is quite equal to the average Blake telephone, and some better, I have designed yet another form of instrument specially for the work of long-range transmission, or where very unusually loud effects are wanted. For long I have maintained that the clue to long-range telephony is to use much more powerful transmitters and much less sensitive receivers. The more powerful transmitter will require strong currents to pass through it in order that it may produce strong variations of current. But strong currents—currents of from $\frac{1}{10}$ of an ampère to one or two ampères—are out of the question where only one or two or even six contact-points are used. Too strong a current through any one contact-point ruins its working. We know, both from the researches of Mr. Bidwell, from the theory of Dr. Moser, and from the experience of Wollaston and Ader transmitters, that the right solution to the problem of arranging a set of microphones in the most effective way is to place them all "in parallel" with one another, so that the main current divides itself between all the contacts. If, however, a set of microphonic pencils are placed simply all in parallel, there occurs a practical difficulty, namely, that the least sensitive microphone is that which will receive the greatest current; and, moreover, if the attempt is further made to provide the set of microphones with electricity at a constant potential, then there is a continual liability for one contact to become overheated and spoiled. The ordinary way—for example, in the Crossley and Ader telephones—of arranging microphones is to attach them side by side beneath the under surface of a sounding-board. This arrangement seems to be open to the objection that the various parts of the sounding-board do not move simultaneously in the same direction; some are heaving up at the moment when other parts are moving down. The wonder is, that such a transmitter works as well as it does. The transmitter that I have constructed for this special work has many microphones—108 in all, arranged in 54 parallels, the pencils being two in series. They can also be arranged all in parallel if desired. As Fig. 5 shows, they are grouped in multiple-grids. Each grid or layer contains 12 microphones, and the motion is communicated to them by a central vertical rod which itself receives its motion from the centre of a mica diaphragm. The impulses do not, of course, pass down the steel rod absolutely instantaneously, but the retardation of phase of even the shrillest of vocal sounds is quite negligibly small. The microphones practically act simultaneously. To each layer of microphones a small resistance coil is added, thus assimilating the practice to that adopted when a set of arc lamps are to be used in parallel. Perhaps it may be worth while to provide a small resistance to each pair of pencils hereafter. When there are so many microphones to be carried, although the voice-waves are concentrated by a diaphragm of five inches in diameter, the amplitude of vibration imparted is not very great, probably not much greater than would be imparted by the voice acting upon the microphones direct if the diaphragm were removed. This mode of using the transmitter is, by the way, quite successful. But if the number were further increased, the amplitude of motion imparted by the diaphragm would be insufficient. Hence I have sought other ways of obtaining mechanically the requisite energy, leaving to the voice the work of controlling the motions. A method of doing this, which promises good results, was suggested by Edison's "motographic" receiver. Against a slowly-rotating friction-roller presses an extension of the rod that supports the central bars of the layers of microphones, and agitates them with a drag and slip motion. The voice is made to affect the pressure upon the slipping surfaces, and so control the periods of drag and slip. The crude notion is represented in Fig. 6. In experimenting in this direction several points of interest in the theory of microphonic contact presented themselves, and are worthy of attention.

EFFECTS OF HEAT ON MICROPHONIC CONTACTS.

First of these points was the effect of heat on microphonic contacts. It is a matter of common knowledge that microphonic contacts work more satisfactorily when warm than when cold. Hunning's transmitters of granulated coke work best when heated by the current. Ochorowicz has produced a special telephone transmitter—the details of which are still kept from publication—in which a preliminary heating is brought about by using a powerful current. I have tried various arrangements of microphones in which heat was led from a small gas jet by copper rods or tubes to heat the working contacts, but have not arrived at any final form. At one time I was under the impression that the heat served simply or chiefly to increase the energy of the vibrations imparted by the voice. But further experiment showed that this was at least a crude view, for I found that if one of the two pieces in contact was heated, the microphonic joint became more sensitive to sound when the other was kept cool. In fact the actual transfer of heat across the loose contact of the circuit seems to facilitate its action as a telephonic transmitter. In studying this point I came upon another fact, namely, that the layer of vapor which exists between a drop of acidulated water in the so-called spheroidal state and the hot metal plate beneath it will also act as a microphonic transmitter, though from its high resistance and instability it is a rather unmanageable sort of transmitter. Now we know from the researches of Dr. G. Johnson Stoney, Professor G. F. Fitzgerald, Professor Barrett, and Mr. R. Moss, that the layer of vapor which supports the spheroid is in the state of so-called "heat-polarization;" that is to say, having a peculiar stress in it transversely to the layer. The researches of this group of distinguished scientific men have shown that there is a distinct relation between the stress across the layer and the difference of temperature between its surfaces. Between these layers heat is passing by a process, termed "penetration" by Dr. Stoney, the essence of which is that the molecules which are traveling across the layer from the hot to the cold side are moving faster than those which are traveling in the contrary direction. That such a layer can conduct an electric current proves that the molecules in their flights across the layer carry electric charges upon them, exactly as do the flying mole-

* Read before the Society of Telegraph Engineers and Electricians Jan. 27, 1887.

cules in the highly attenuated vapor of a vacuum tube. It is indeed significant that our Vice-President, Mr. Crookes, himself suggested, so far back as 1874, that the phenomena of the "spheroidal state" were due to the same causes as those he was studying in the repulsion which he found to exist between two bodies, one of which is hotter than the other, as in the case of the blackened vanes of the radiometer and its inclosing bulb. If this view be correct, the apparent resistance of a layer of flying particles ought to be proportional—*caeteris paribus*—to the number of molecular impacts per second, and this in turn will be proportional to the area of the layer, and inversely proportional to its thickness. It is possible that it may be a novel idea to some members of the society that if an insulated conductor of a given size is flying backwards and forwards in a regular periodic manner between two surfaces, one of which is at a higher electric potential than the other, it will act as a conductor of measurable apparent resistance. An ordinary electric bell, while ringing, possesses a measurable apparent resistance quite different from its resistance when standing still, and dependent on the frequency of its vibrations and on the length of path at the contacts, as well as on the nature of the contacts. Maxwell suggested, and Mr. Glazebrook has used, a method for measuring the capacity of a condenser by measuring the apparent resistance of a vibrating contact apparatus, an electrically maintained tuning fork of known pitch. There is then good reason to think that a layer containing hundreds of thousands or even millions of molecules flying to and fro between its bounding surfaces will have a measurable resistance, even though the whole phenomenon be one of minute discontinuous discharges. Suppose that an interrupter like the hammer of an electric bell or the rheotome of an ordinary induction coil could be made to vibrate at a pitch higher than the highest audible sound,—say, at 45,000 vibrations per second,—we might measure its resistance without being able in the least to tell that it was not an ordinary resistance. It would probably vary considerably with pressure. But here we come to the question whether the entire phenomenon of elasticity is not due to incessant minute motions; a question too wide to discuss here, and itself only part of a still wider question whether all potential energy, so-called, is not really kinetic energy after all.

Returning from this point to the more familiar one of the cause of the action between the two surfaces of a microphonic joint, let it be observed that there is an obvious incompleteness about both of the rough-and-ready theories which are commonly accepted, viz., that microphonic action is due (1) to the variation of resistance of the material under pressure, and (2) to the variation of the number of points of contact between the surfaces. The first view is known to be wrong: but is not the second, as thus stated, terribly imperfect? Little as we know yet about the exact kind of motion which constitutes heat in a body, we know at least this, that the heat in a solid body is a motion, vibratory, oscillatory or rotatory of its particles. We know that the surface particles of every substance that is not at the absolute zero of temperature are animated incessantly with minute motions which are of an irregular kind not timed together, otherwise the body would emit rays of one frequency only, not all executed in the same direction at the same instant, otherwise the emitted rays would be polarized rays. We know that their average amplitudes increase, and that their average frequencies also increase, with increase of temperature; but this brings us almost, if not quite, to the boundary of present knowledge. We know, further, that the most highly polished surfaces we can obtain may be, molecularly speaking, quite rough. A ridged surface whose corrugations are less than a half-millionth of an inch in breadth is perfectly flat to all optical tests, but such ridges might contain from five hundred to two thousand rows of separate molecules. A metal surface one millionth of an inch square may have from four to sixteen thousand molecules on its top surface. Think of two surfaces such as we have to deal with in telephonic transmitters, say one of platinum and one of carbon. Both rough, both heated by the passage of the electric current, that is to say, each having its molecules in violent agitation, and ready to discharge electricity from the surface of higher to that of lower potential. Let these two be resting lightly in what we commonly call "contact:" what a jostling of molecules, what innumerable batterings, what millions of minute electric discharges; air particles, nay, even solid dust particles torn from the two surfaces, flying to and fro between them, forming a veritable Crookes' layer. Then think what is the meaning of putting more pressure on to such a "contact." The thousands of molecular makes and breaks that were going on will be multiplied; the paths of the flying molecules shortened; more current will flow; heat agitations become still more energetic. Take off the pressure, the two surfaces fling one another apart, or bombard one another apart; discharge takes place more slowly; the apparent conductivity of the layer is reduced. Move the surfaces still further apart, the atomic clash and atomic bombardment is still further enfeebled. Separate them by a visible distance like the spheroidal drop separated visibly from the hot plate beneath it—still there are the flying molecules at work between them. Will any one undertake to say that at sensible distances, such as one-thousandth of an inch, or even one-hundreth of an inch apart, no discharge takes place at all across the gap? Think of this, and then meditate on the shallowness of the dictum that when two clean platinum contacts are used in a transmitter, the current must be either wholly on or wholly off, either "made" or "broken," with a sharp transition *per saltum* between the state when the two surfaces are in perfect contact and the state when the two surfaces are not in contact at all. Think of the utter fatuity of the dictum that a transmitter cannot transmit unless the contact surfaces are "semi-conductors." The more one thinks of the matter from the point of view of the molecular vibrations, the more plain is it that every transmitter that works by varying the resistance of the circuit—every one of Class I. in the table of transmitters—works by varying the number of molecular contacts, and that the most perfect transmitter will be the one that does this in the most effective correspondence with the displacements in the air caused by the speaker's voice, and will give the effect of undulation when the air particles merely undulate, and will give the effect of intermission when there is is intermission between the motions.

The foregoing considerations will perhaps make more intelligible the action of heat in assisting microphonic action. It is my opinion that what heat can do can also be done by auxiliary vibrations of such periods as shall not interfere with the tones of the voice. I have had an apparatus lately constructed to test this matter.

INTERMITTENCE IN VIBRATIONS.

It was remarked earlier in this paper that the noise commonly attributed to "make and break" is really due to sparks; and that if these are suppressed, "break" produces no more noise than "make." Under these circumstances speech is perfectly transmitted by sensitive arrangements in which otherwise the speech might be drowned by the spark-rattle. The mere fact that the vibrations corresponding to a certain sound stop for a short time, does not necessarily produce on our ears any discontinuity in the sound. Nay, if, for example, the vowel "*a*" is being sounded in a telephone, the receiver at the other end will continue to emit the same sound, even though the electric impulses are occasionally interrupted. Impulses,

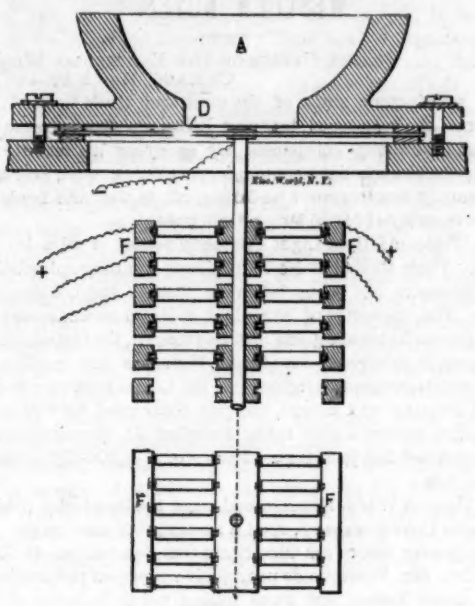


FIG. 5.

large and small, discontinuous in themselves, if rightly timed, will suffice to set up any desired form of vibration upon a proper receiving tympanum. Take a complex sound such as that represented in the curve *A*, Fig. 7. We know that if we translate this into electric undulations of

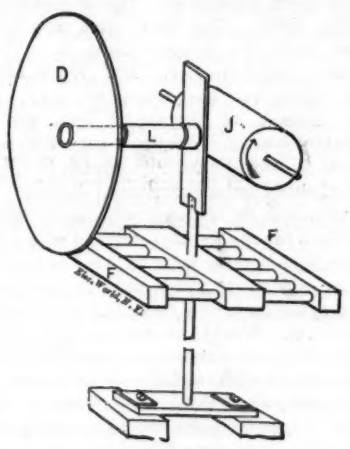


FIG. 6.

the form either *B* or *C*, we shall get the same sound reproduced in the receiver. But we also get the same complex sound by the discontinuous impulses of intermittent electric currents such as are represented graphically by *D* and *E*, provided the discontinuous impulses, large and small,

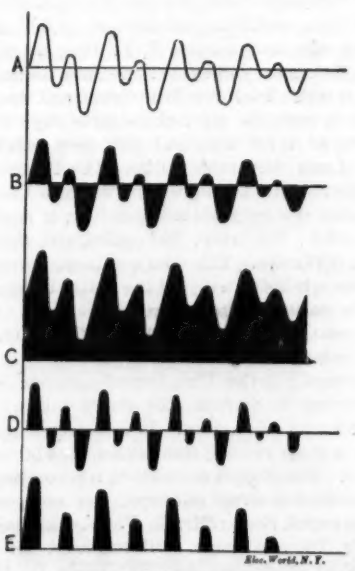


FIG. 7.

are rightly timed and proportioned. To assert that discontinuous electric impulses cannot set up and maintain a continuous vibration in the armature of a telephone receiver would be as absurd as to assert that discontinuous impulses cannot set up and maintain the continuous rotation of a fly-wheel or the continuous oscillation of a swing. But it is hardly worth while to prove by argument what has been abundantly demonstrated in fact.

(To be continued.)

To Scare Off Thieves.—Mrs. Hicks-Lord, whose house was plundered recently, has sent a petition to the Aldermen asking that Washington place be lighted with electric lights. She will maintain an arc light in front of her house.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
NEW YORK, March 21, 1887.

I notice that Mayor Hewitt, at the meeting of the Gas Commission last week, suggested that some test as to candle-power of the electric lights be made before the usual contracts were awarded. Gen. Newton, the Commissioneer of Public Works, said that in his opinion many of the electric lights used by private persons were not high enough above the sidewalks to afford sufficient brilliancy and avoid danger to life and property. He also stated that the elevation of such lights was not in compliance with city ordinances, and that he would investigate the matter.

Over in Brooklyn, the trouble over the lighting service, for which the appropriation is insufficient, has been settled by a slight cutting in rates. I am heartily glad there are to be about as many arcs as usual. When a man can be shot in his house on a dark, gas-lamp street, as was Mr. Weeks, I, as a resident in Brooklyn, think it a great shame there are not more electric lights, for the sake of safety.

Mr. C. E. Chinnock, a right, good man, has been elected Vice-President of the Edison United Manufacturing Company, and will assume his duties at 65 Fifth avenue to-day. Mr. J. Hutchinson, the general manager, is as busy as ever. Since January 1, this company has put in some 34,000 lights in isolated plants, including the Tuxedo Park Club-house, 1,000; the Aldrich Building this city, 3,000; the Hotel Ponce De Leon, St. Augustine, Fla., 2,000; Custom-House and Post-Office, New Orleans, 1,500. Noll Brothers are doing all the wiring for this work, and I understand that Callender cables are going into nearly all these places.

E. P. Hampson & Co., through Mr. W. F. Haring, have just put in a 50 h. p. steam plant for the new big store of F. Loeser & Co., at the junction of De Kalb and Fulton avenues, Brooklyn, running 60 arc lamps of the Excelsior system, put in by the Excelsior Electric Company. Also, 70 h. p. for the Excelsior plant of nearly 100 arcs in Sweetser, Pembroke & Co.'s, Broadway, this city; 50 h. p. for James Hearn, Fourteenth street, to run a Waterhouse plant; 50 h. p. for the Ebling brewery, with electric lights; 50 h. p. for Cable's restaurant, with Edison lights; 30 h. p. for the American Exchange National Bank, to run a 300-light Sawyer-Man plant.

E. P. Bullard will, on and after April 1, receive his friends and customers at his new machinery warerooms, 72 Warren street and 62 College Place, where he will have a full line of machines and tools as usual.

James L. Morgan & Co., 47 Fulton street, this city, are importers and manufacturers of blue vitriol, sal ammoniac, sulphuric acid, etc. They quote the market price of blue vitriol just now at 4¼ cents.

Alfred T. Parson & Co., 4 Cedar street, say that their "Beltoline," for keeping belts and pulleys perfectly clean, is in good demand.

I hear that the West Brooklyn Land and Improvement Company, 18 William street, are going to put in an electric light plant. The Hempstead (L. I.) Gas-Light Company also votes for electricity.

The Electrical Accumulator Company, 44 Broadway, are not so busy with law suits that they cannot attend to other matters. Their factory is busy "right along." One of the plants they are putting in is that in the Royal Insurance Building, this city.

A very novel plant of 400 lights has recently been completed at the New York Fire Department Headquarters, under the supervision of W. H. McGrath, chief engineer of the Brush Electric Illuminating Company, of New York. There are all sorts of automatic contrivances about this plant which have greatly pleased the firemen and officials. The running in and out of a fire engine switches certain lamps on or off, as may be desired. This plant will well repay a visit from anyone interested in electrical matters. Two Brush incandescent dynamos are used, with Swan lamps of 95 volts.

The incandescent lighting at the New York Life Insurance Company's head office building on Broadway is unusually attractive. The plant consists of 1,000 Swan lamps, the current for which is furnished by three compound-wound Brush dynamos. These dynamos were started before the wiring was complete, and there has been no hitch or stoppage at any time since. The motive power is furnished by two Watts-Campbell Corliss engines.

Steinhardt & Son, the uptown bankers, who put an Edison plant not long ago in one of their apartment houses, are now putting in a Sawyer-Man plant in another very large block near by, at Sixtieth street and Ninth avenue.

The New Haven Clock Company are putting in an independent electric light plant in their handsome salesrooms, 16 and 18 Park Place, and are prepared to give estimates for any size incandescent plants.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
BOSTON, March 21, 1887.

The Schuyler Electric Light Company, of Hartford, Conn., has reorganized and has a new charter. Charles E. Dustin is president and C. H. Sewall secretary.

The Brush-Swan system has been introduced in Brunswick, Me. On the evening of March 10, as previously referred to, the company started up 50 arc lights (Brush) and 500 incandescent (Brush-Swan) lights.

The Simplex Electrical Company, of Boston, reports increased sales and a more widespread demand for its Campbell (T. Z. R.) wire. The manager of the company, Dr. A. P. Mason, recently informed me that his company was in receipt of several large duplicate orders, among which were some from electric light companies who had already tested and used the Campbell wire to their satisfaction.

On March 16 the hearing on the subject of limiting telephone rates was continued before the Committee on Mercantile Affairs at the Massachusetts State House. The remonstrants opened their side of the case with an argument by Hon. Geo. A. Bruce, counsel for the American Bell Telephone Company.

A number of messenger boys, who were formerly with the Boston District Messenger Service, but more recently employed by the Limited Line's Telegraph Company, went out on a strike last week, but the refusal of the company to yield to the demands of

the youthful strikers, together with the immediate discharge of the leaders, quickly induced the boys to return to their work.

Messrs. Houghton, Mifflin & Co., publishers, have just off the press a work by T. C. Mendenhall, entitled *A Century of Electricity*. The publishers thus invite attention to the book: The story of the discovery of the properties and uses of electricity seems almost to belong to the domain of romance and magic. It is one of the great marvels of the century, and its story is extremely interesting. Professor Mendenhall is widely known as one of the most learned and experienced of living students of this subject. He knows all that has hitherto been discovered in regard to electricity, and in this book he presents its history and science in a popular form.

The Waterhouse system of electric lighting while in its experimental state was looked at with considerable interest by many interested in such matters, because it was a break from the old methods and was claimed by its promoters as "an advance in the art." The experimental state having passed, the system has been successfully installed and is doing excellent service, showing that in so short a period it ranks among the best systems now in the field. The Waterhouse Electric and Manufacturing Company, Hartford, Conn., has just completed the installation of a 100-arc light plant for the Newark Schuyler Electric Light Company, Newark, N. J.

A report is being circulated here that the recently organized Boston Electric Light Company has "swallowed up" the New England Weston Electric Light Company. If true, then the prediction made a year or more ago by "knowing ones" has been verified, and the long-looked-for "triple alliance" between the Hub's local electric lighting companies has been consummated at last. As is already familiar to the reader, the Brush and the Merchants companies joined interests in the autumn of 1886 under the newly incorporated name of the Boston Electric Light Company, and since the beginning of the present year only two local companies, instead of three as formerly, have been furnishing electric lights for street lighting, viz., the new company just named and the New England Weston Company. Just why the latter company did not become a participant in consolidation above referred to is a question that has been frequently agitated in electrical circles here, but a satisfactory solution to this riddle, if any, has not yet been made public. It is believed, however, by many electric lig t people in this section, that if the New England Weston Company had desired to become the third party to the enterprise at the time the consolidation was effected, this could have been accomplished.

The Riley Elevated Railway Company, of New York, has established offices in Boston, at No. 93 Milk street. Mr. F. A. Bartholomew, president of the company, will be permanently in charge, and will take pleasure in exhibiting and explaining the working models and many designs of the Riley system. A very attractive catalogue is being issued by the company, giving quite a number of illustrations of cars and structures, together with interesting and comprehensive descriptions of the entire system. The contents of the catalogue show that the construction of the roadway consists practically of a single girder, attached to the top of which is the main or single bearing rail. About two feet below this centre rail, and parallel with it, runs a light rail. The centre rail practically supports the weight of the car, and the lower side rails act as balances. The centre wheels, one before the other, run upon the rail, and are double flanged. The lower wheels are single flanged, and are set midway between the centre wheels, one on each side. The truck is centrally pivoted, like the ordinary bogie truck, and adapts itself to sharp curves very nicely, as shown by the models.

The Boston *Commercial Bulletin* of March 19 devoted nearly a half column to the praise of Vermont's lovely capital. Among the many kind words expressed are the following:

"Montpelier has had a rapid growth for the last six years, and its citizens, to show their growing interest in its advantages, as a town to invite new business, have voted to exempt all new manufactures from taxation for a term of years. The town has a water power from two streams running through it, with a fall of 350 feet. Montpelier is situated in the centre of the State, in direct communication with all the lumber districts of Northern New England, and near an extensive local lumber region. Two lines of railroad connect it with all New England points, New York and the West. It is the best lighted town in New England, with electric light and gas. Its fire protection and insurance rates are complete. Its banking and financial institutions are acknowledged to be superior and are sufficient for all business purposes."

The leading theme of interest in electrical circles in New England has been the opening of the Worcester Exhibition, where everything is driven solely by electricity, Daft generators and motors being used exclusively, and with great success for this purpose. The exhibition was opened with great éclat on March 14, by Governor Ames, and among the distinguished speakers and guests were Senator Hoar, Hons. W. W. Rice, J. E. Russell, Mayor Winslow, and Leo Daft. The credit of organizing this "Industrial, Mechanical, Electrical and Mercantile Exhibition" is due to Mr. H. H. Bigelow. As might be expected, the attendance is very good, running over 2,000 per day.

The rink building in which the exhibition is held is situated in the centre of the city, and has a floor space of 125 by 225 feet. Among the electric exhibitors is the Schaefer Electric Light Company, of Boston, who will have about 75 lights of 16 and 25 c. p. This company has a small office very neatly fitted up, and in which it has ten 16 c. p. lamps. It has also a very good space outside of the office, in which will be placed one 50 light dynamo run by a Daft motor. The Schaefer Company also furnishes lights in the exhibits of Barnard Sumner & Co., Clark, Sawyer & Co., the Remington typewriter office, and in several other places.

The shafting is run by two Daft motors, one of 4 h. p. and one of 2 h. p. The Daft motors running the special machinery are as follows: One of 6 h. p., which is running the exhibit of the Schaefer Light Company for fifty lights; one 6 h. p., running the Tremont Electric Light Company's exhibit, one of fifty and one of 25 incandescent lights; one 6 h. p., running the elevator; one 2 h. p., running the exhibit of the Worcester Free Institute; one of 4 h. p., running the Sturtevant blower; one of 1 h. p., running the hoisting derrick; and one of 6 h. p., running the Daft electric railway. The Daft Company has also on exhibit a 60 h. p. dynamo.

There are a large number of mechanical exhibits which are running from the shafting, among the larger being the Washburn & Moen Manufacturing Company, who are making copper wire for electrical purposes and barb wire fencing; the Gilbert Loom Company running one loom and two cloth inspecting machines; the Crompton Loom Company, running one wool comber; the Wright Machine Company, who are running engine and water wheel governors; the Boston Bonnet & Bleachery Company, who are manufacturing bonnets; the Singer Sewing Machine Company, and many others. The exhibition has all its power furnished by electricity, and it is the first mechanical exhibition held in Worcester for twenty years. A very general interest is manifested in the exhibits. The facilities for running the exhibit are contributed by the Worcester Electric Light & Power Company.

W. I. B.

WESTERN NOTES.

Branch Office of The Electrical World,
Chicago, March 19, 1887.

The satisfactory state of the electrical trade in the West still continues, the volume of business being on the increase in fact. The manufacturing companies are enjoying a first rate run of orders; the electric light companies are doing well, and the electrical supply houses report no falling off in the fine trade which they have enjoyed for so long a time now.

The Western Edison Light Company report a nice lot of late orders. Their station at New Orleans is running splendidly, and new consumers are being taken as fast as the buildings can be wired. The capacity of this plant is 9,000 incandescent lights; 3,000 Edison lights are going into Dayton, O., the installation work now being in progress. La Crosse, Wis., has just contracted for 4,000 of this company's lights, and the Crane Brothers Manufacturing Company, at Chicago, has just contracted for 600 more. A 3,000-light station is now being installed at Birmingham, Ala., and a contract has just been closed for a 2,500-light station at Mobile, Ala.

Mr. Thomas Ward, Superintendent of the Sandusky (Ohio) Gas Light and Coke Company, read a remarkably able paper on gas and electricity before the Ohio State Gas Convention at Dayton, March 16. Mr. Ward holds progressive views on this subject, and in his paper brings out some telling points in favor of the gas companies taking hold of the electric light. He covers the ground thoroughly, leaving not a stone unturned nor an argument unanswered. Gas men who read this paper will learn that there were just as many objections brought against gas, when it was first introduced away back in 1809, as there now are from some few quarters against the electric light. The element of danger was then brought forward, but time showed that gas properly handled was far from dangerous. This is and will be the case with the electric light. Gas men must not hug to themselves the idea that the electric light is only a temporary craze; they must rather, Mr. Ward says, conclude that the new illuminant has come to stay, and handle it themselves instead of letting it get into the hands of local and rival companies. They are only different kinds of light, and no hostility should exist between the two. The electric light is a practical thing and a commercial success. In order to show how ridiculous it is for the gas companies to oppose the electric light, Mr. Ward takes a typical case and says: "Suppose a manufacturer has been making a special kind of goods for a large customer for a series of thirty years, and this customer at the end of that time desires the form or style of the goods so furnished to be changed somewhat. Would you deem it business policy to let that patron of thirty years' standing go elsewhere for his goods just because you did not wish to change your pattern or modify the style of manufacture? I think not. You are furnishers of light, and if your customers desire you to furnish a certain kind of light, you should be able and willing to do it, no matter if it does differ from the light you have heretofore been furnishing them." Mr. Ward is thoroughly posted in both gas and electric light matters, and his opinions are entitled to great weight.

The Western Electric Company have just received an order for four more sections of multiple switch-board for Cincinnati. They have also just finished laying eight miles of underground and four miles of aërial Patterson cable for the Metropolitan Telephone Company, New York, and have just shipped 13,000 feet of the Patterson type of cable to Syracuse, N. Y. They are now at work on the following orders for this cable: one mile underground for Detroit; one-half mile aërial for Milwaukee, and two 100-wire armored cables to cross the river at the same city; also several short cables two or three thousand feet long each for Boston, Richmond, St. Louis and other cities. The Patterson cable is popular, and during last December the Western Electric Company sold 401 miles of wire made into this form of cable; during January, 657 miles: February, 851 miles, and the first three weeks in March, 600 miles. This does not include any lead tape cable made for switch-board use. Of the latter there were 1,069 miles of wire sold during the same time.

Mr. C. A. Brown, of the Western Electric Company, is now on a trip through the South and East.

I notice that several of the Van Depoele electric roads have lately been receiving visits from the street railway officials of Cincinnati, Boston and other cities. It is interesting to observe that the reports of these visiting committees have been favorable in every instance. The Boston committee, representing a syndicate largely interested in street railways, was composed of Mr. Potter, of the Maverick Bank; Mr. G. T. W. Braman, Col. Albert A. Pope, Mr. Thomas Doane, civil engineer, Mr. Frank L. Pope, the New York electrician, and Mr. Henry D. Hyde. Mr. Hyde said to a reporter: "We were at Scranton, Monday, for the purpose of inspecting the electrical street railway in operation there. As Mr. Frank Pope had previously seen it, we went there without giving any notice of our purpose, and went over the line of the road in the cars and back, stopping at an intermediate point, and making, as far as we could, a careful examination of the road in its operation. We all came away satisfied that electricity as a motive power for street railways has come, and while many details of application and convenience will yet be added to it, the success of the thing seems to be assured. The car was geared for running five miles an hour up the heavy grades, and on the level stretches fifteen miles an hour. Both rates of speed were easily made, and the car ran easily, steadily and was in full control of the driver, if he may so be called. The motor is placed on the front platform, which is inclosed very much like a pilot house, where also is a hand-brake, by which the speed of the car is controlled and checked. The whole handling of the car is very simple and effective. * * * * None of us, with the exception of Mr. Frank L. Pope, had any special knowledge of electricity or its application, and yet the whole arrangement seemed to all of us very simple and effective, and I shall look for as rapid a development of electricity as a motive power in the propelling of street cars as we have seen in the improvement of the electric light since it first came, and it seems at once feasible and practicable." Mr. Hyde further said it was very probable that by next autumn his people would have several miles of electric railway in operation in and around Boston.

The committee which visited Appleton, Wis., represented 96 miles of street railroad at Cincinnati, O., now using 250 cars and 1,900 horses. These visitors were also highly pleased; and well they might be, for they saw an electric railroad which operates perfectly. The car on which they rode was loaded down to its utmost capacity with people, but it moved off easily and smoothly, just as it does every day in the year to the extent of 90 miles every 15 hours, down the avenue, around the curve on to Meade street, around the curve on Pacific street, down Pacific street to Bellaire Park Bridge, down the hill on to the bridge, up the hill on an 8 per cent. grade with a curve, to a sharp curve around and on to the turn-table. The car was turned around and made the return trip, during which it easily ascended two grades, one of 4 per cent. and another of 5 per cent. It will be remembered that there are five electric cars on the Appleton system, and three more have been ordered.

The favorable reports of these two committees speak volumes for the electric motor generally, and for the Van Depoele motor in particular, for both the Scranton and Appleton roads use the Van Depoele system.

General Manager Barton, of the Thomson-Houston Company, spends a good share of his time in Chicago nowadays. Business has been very active with his company since the first of the year and the following is a partial list of plants installed by them since Jan. 1: Terre Haute, Ind., 45 arc; Kansas City, Mo., 90 arc; Reno, Nev., 45 arc; Larned, Kan., 18 arc; Cleveland, O., 800 incandescent; Milwaukee, Wis., 100 arc; Lima, O., 45 arc; Lima, O., 400 incandescent; Joplin, Mo., 60 arc; Hillsdale, Mich., 45 arc; Sheboygan, Mich., 45 arc; Miles City, Mont., 30 arc; Bozeman, Mont., 30 arc; Billings, Mont., 30 arc; Jackson, Mich., 100 arc; Battle Creek, Mich., 100 arc; Wahoo, Neb., 300 incandescent; Litchfield, Ill., 30 arc; Atchison, Kan., 30 arc; Houghton, Kan., 45 arc; Duluth, Minn., 25 arc; St. Louis, Mo., 50 arc; Warsaw, Ind., 30 arc; San Francisco, Cal., 50 arc; Woodlawn, C. I., 45 arc; Seattle, Wash. Ter., 25 arc; Nevada, Mo., 30 arc; Ryerson Building, Chicago, 20 arc; Studebaker Bros., Chicago, 45 arc; Studebaker Bros., Chicago, 75 incandescent. The company has now on hand unfilled contracts in the west for 475 arc lights and 3,600 incandescents.

I met Mr. J. H. Harding, manager of the Laporte, Ind., Van Depoele Electric Light Company, in Chicago yesterday. His company is now running 45 arc lights, mostly for commercial lighting purposes. They expect soon to go into street lighting quite extensively.

Munson & Company have lately furnished their electric light belting to John Wanamaker, Philadelphia; the Abbott & Wonder station, Chicago, the main belt of which is 28 inches wide. They have fitted up the Edison plant in the City Hall with belting, and also furnished the same company with a main belt for their plant at Elgin. Other orders are for the Manistee Salt and Lumber Company, Manistee, Mich.; Rice Lake Mill, Rice Lake, Wis.; Chippewa Lumber and Boom Company, Chippewa Falls, Wis.; Empire Lumber Company, Winona, Minn.

One of the Amet electric water-wheel governors, manufactured by Mr. H. A. Streeter, Chicago, has just gone to Beloit, Wis.

The Railway Telegraph Supply Company report a very favorable reception for their new fire alarm box and brisk sales.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes me the following telephone stock quotations:

Bell of Mo.	$155@$157
Central Union	54@ 55
Chicago	375@ 400
Colorado	20@ 22
Cumberland	80@ 85
Great Southern	30@ 33
Michigan	72@ 73
Rocky Mountain Bell	40@ 45
Wisconsin	104@ 106

W. A. K

Cincinnati, O., March 21, 1887.

I do not think that Cincinnati is any way behind her neighbors in the matter of electrical advancement. I believe we have a fair showing of every class of electrical apparatus here except the electric railway—and that is coming, as the electric motors in use in various parts of the city are running most satisfactorily.

The electric lighting business has become such a menace to the gas interests here as to cause the latter to make some very considerable concessions to their best patrons. A city ordinance recently passed reduces the price of gas from $1.60 to $1.15 per 1,000, but our electric light people, so far from being troubled, are going ahead in fine shape. The First Cincinnati Edison Electric Illuminating Company, which began business at the corner of Fourth and Vine streets within the past year, are substituting their lights for gas in a great many prominent stores and buildings. They have already supplied the Western Union Telegraph Building, the St. Nicholas Hotel, Hotel Emery, Duhme & Co.'s large jewelry palace and other extensive establishments.

In the manufacturing and supply line, Cincinnati keeps abreast as usual. The Standard Electrical Works report a brisk trade in their well-known specialties.

St. Paul, Minn., March 14, 1887.

The Edison Electric Light Company, of this place, started on the 16th of last month and has been in operation since then without a single interruption. All the work was done by the Marr Construction Company, of Harrisburg, Pa. H. M. Doubleday, superintendent for that company, and Thos. Spencer, their electrician, personally superintended the work, and it is needless to say it is well done. It would repay any one wishing to see a perfect piece of work to inspect this plant. The building is without doubt as fine as any devoted to the business. Five Buckeye engine

of 150 horse-power each and ten No. 20 dynamos are placed in the engine-room, with due regard to economy of space and ease in handling. The electrical apparatus is placed in the most advantageous way, several novel features being introduced by Mr. Spencer in the arrangement. At present the load is over 3,500 lamps. I may also report the motor business as being very lively. The motors of the Sprague and C. & C. type seem to be very much liked and give great satisfaction. The gas company using the American system of arc lighting are also doing a thriving business with their incandescent as well as arc circuits. In short, the business in this section is booming. New plants are talked of in several cities near by; probably the next towns to fall in line will be Minneapolis and Milwaukee.

ST. LOUIS, Mo., March 15, 1887.

The electrical business in St. Louis is booming at present and there are splendid prospects for summer trade. Your Western representative, Mr. Kreidler, was so lately over this ground that there is little now left to say, but I can give a few points.

The Railway Telegraph Supply Company, P. C. Burns, manager, have a prosperous trade and are building up a good business through the entire region of the Southwest. They have contracts for electric bells in five large hotels at Hot Springs, Arkansas, the Rock Island House at Rock Island, Ill., and several hotels in Kansas. They have also some fire-alarm telegraph contracts in hand.

The St. Louis Battery Manufacturing Company are turning out lots of their new microphone battery, and find it equal to all demands.

The Heisler Company, of this city, is doing well, and is very busy filling orders for its incandescent lighting system.

I understand that the Edison Company are about to furnish a large municipal central station plant for Kansas City. They have recently placed some fine large plants at Topeka, Abilene and Hutchinson, all in Kansas. The construction work in these places was done by the Western Electric Construction Company, of St. Louis.

HUTCHINSON, Kan., March 15, 1887.

This city is doing well in the matter of electrical growth. The Edison plant lately installed here is working nicely, and the outlook for the electric light is excellent. The manner of the introduction of the light is so novel that it deserves a special word. We have here a unique and complete combination of water, light and telephone service, operated by the Hutchinson Water, Light and Telephone Company, of which Mr. J. S. Drake is manager and Mr. L. A. Beebe secretary, treasurer, etc. All under one roof is a large Holly water-works system, a 2,000-light Edison plant, probably the finest of its size in the West, and a telephone exchange of 150 subscribers. All the apparatus is the best, and it gives the most satisfactory service. Arc lights are to be added as soon as possible.

KANSAS CITY, Mo., March 19, 1887.

The trade of this remarkable city grows by night as well as by day, and already we are beginning to feel the burdens and responsibilities of greatness. Not only does Kansas City serve as a depot for an immense and fertile region, but she has within herself many elements of growth. The consequence is that her population is increasing tremendously, and that electricity has no small part to play in meeting the new wants of the new time. One might well suppose that the real estate speculation, in which not a few electrical people have a hand, would occupy all the energies of the place, so active is it; but, on the contrary, it seems to be merely a recreation, as all kinds of trade and business keep spurting with a vigor that grows by what it feeds upon.

Mr. Theo. P. Bailey, representing the Thomson-Houston Company here, says that business is particularly bright with him. The local Kansas City Electric Light Company has its hands full of new work, and is evidently keeping a keen and intelligent eye fixed on all the new developments. There is plenty of talk about the new Edison station here, and altogether electric light interests are in good shape.

Messrs. O. W. Ditsch and H. J. Brunner, and the Kansas City Electric Works all report business good, especially in the electric bell line.

The Pacific Mutual Telegraph Company is about to extend its lines.

The Kansas City telephone exchange is still growing at a terrific pace. I don't know what the management is going to do with its new subscribers, who are already well nigh too numerous to handle, and who are only given the good service they get by judicious and skillful handling of the apparatus, so as to make it do the best it is capable of.

I may here tell a good story of land speculation. A well-known electrical supply man was at Wichita, Kan., recently. A real estate dealer took him out in the country several miles and tried to sell him a town lot. "If I buy this lot," said the electrician, "and build, where shall I get my mail—in Wichita or Hutchinson?" The man said: "At Wichita, of course." The electrician replied that he only asked the question because a real estate man in Hutchinson had offered him the same lot as being a town lot in Hutchinson!

SOUTHERN NOTES.

CHATTANOOGA, Tenn., March 17, 1887.

The East Tennessee Telephone Company has exchanges in this city, Knoxville and Clarksville in Tennessee; Lexington, Paducah, Bowling Green, Frankfort, Cynthiana, Paris, Winchester and Hopkinsville in Kentucky. The Law system is used in all these exchanges, as it is in all the exchanges of the Southern Bell Telephone Company. The Chattanooga exchange has 276 subscribers and is growing, 24 new subscribers coming in during February. The rates are $60 a year, in advance; six months, at the rate of $32, and quarterly at the rate of $64. Chattanooga has toll lines to Cincinnati and Louisville. Mr. J. M. K. Dunscomb is manager of the exchange and Mr. R. Segasser, inspector. The exchange is kept open continuously. There are two day and two night operators. About 110 miles of wire, No. 14 steel, are in use in the city. The poles are tall and comely, and the lines are well built, but the line on the principal thoroughfare, Market street, is shortly to be reconstructed with 60-foot poles.

Mr. S. C. Dodge was Superintendent of the Chattanooga Brush station when it was first started, then resigned and formed a connection with the Brush station at Louisville, but has just returned to his old love. The company had not been doing as well as it is now expected it will do under the superintendence of Mr. Dodge. The plant was recently purchase by a local organization, and Mr. Dodge is busy putting it in first-class shape in anticipation of the increase in business he will have to meet. At present the company furnishes about 50 lights. The engine is 75 h. p., made by G. H. Corliss. A lot has been bought upon which a new station will be erected soon.

Dorsey, Paine & Co., of Eighth streeth, and A. H. Doty & Co., do considerable electric bell and annunciator work. There is nothing to report in the telegraph line except a steady gain of business.

NEW ORLEANS, March 16, 1887.

The station of the Louisiana Electric Light & Power Company here, of the Fort Wayne Jenney system, is said to be beyond question the largest in the world. There are 60 dynamos in use, principally 30-lighters. They supply 1,600 lights, 850 for the city and 750 to private consumers. There is one 28×60, and one 32×60 compound condensing Reynolds-Corliss engine, made by E. P. Allis & Co., with a combined 2,000 h. p. There are 20 boilers 6×16, manufactured by the Bass Foundry & Machine Works, of Fort Wayne, all set with Jarvis furnaces. The Munson belting in use is the largest ever made. The three belts are 42, 52 and 64 inches wide. The 64 inch belt is about 150 feet long. One of these belts travels 13,600 feet a minute. The shafting runs from 8 down to 4½ inches diameter. The buildings are large. The dynamo room is 177×75 feet; the engine room 50×90; the boiler room 177×60. The engine room is now in course of completion. The rest of the station was built some time ago. The offices will be in the new part. It is interesting to note that the company formerly had small high speed engines, but have discarded them completely, using the slow speed for economy. They figure this way: High speed engines require about 4½ lbs. of coal per light per hour; low speed about 2½ lbs. On 1,600 lights this gives a saving of 3,200 lbs. an hour; or for 8 hours 25,600 lbs., or nearly 12½ tons per day. This, at $4 a ton, is a saving of $50 a day. The company, therefore, thinks that the large engines, although they cost $50,000, or $30,000 less than the small ones are a good investment.

The Great Southwestern Telephone Company has 11 exchanges, 6 in Louisiana, and 5 in Mississippi. Mr. Fowler is the general manager of the entire system, and looks, also, after the New Orleans exchange in particular, where he has some 1,400 subscribers. Western Electric multiple switch-boards are used, with a capacity of 1,350. The toll lines are principally No. 14 copper, while the local lines are No. 14 steel. There are 17 operators under Mr. E. H. McFall, electrician. The rates are $55 to $96; the toll rates are 25 to 55 cents, and the public station rates are 15 cents for 5 minutes. The toll lines to Bayou Sara are 148 miles long, from Orange to Alahacha Point, 48 miles; and from New Orleans, crossing the river by Kerite cables to Socola Canal, 93 miles, and the extension of the same line to Port Allen, 124 miles; New Orleans to Greenwood, 25 miles; New Orleans to Shell Beach, 28 miles. There are quite a number of other lines, but the above are the most important.

The telegraph business here is quite brisk, New Orleans having a very large Western Union office. The Wheatstone system here finds an extensive use.

It should be mentioned that the Brush electric light is largely patronized, there being several hundred lamps in service. The Custom-House and Post-Office have received an equipment of 1,500 Edison lamps.

GALVESTON, Tex., March 15, 1887.

The telephone exchange here has about 430 subscribers at $5 a month for business and $4 for residences. The exchange is always open, with three day operators, two night and one toll line. The toll rates run from 25 cents to $1 (for five minutes conversation to Austin). Mr. H. C. Caswell, at present at San Antonio, becomes manager of the Galveston exchange on April 1, when Mr. G. W. Foster, the former manager at Galveston, becomes superintendent of the second division of the Erie Company, with headquarters at Austin. Mr. T. W. Millburn, after holding that office for nearly four years, has resigned to take the management of the San Antonio exchange, on account of his family residing in that place. Mr. Foster deserves his promotion, and his wife has been of great service to him, keeping his books and reheving him of much detail worry.

The southwestern division of the Erie Company includes the States of Texas and Arkansas. Mr. E. K. Baker, the superintendent of the first division, with headquarters at Dallas, covers a large territory including a good exchange at Hot Springs, Ark. It is thought that the opposition telephone companies in Kansas are now pretty badly knocked out.

The Brush Electric Lighting Company, of Galveston, is doing a good business. It furnishes fifty 2,000 c. p. arcs for the city, and 125 for private parties, in addition to about 275 incandescents. There are four 65 light, two 28 and one 10 dynamos in use, with two 16 × 32 150 h. p. Buckeye engines, and three 125 h. p. steel boilers made by Smith & Techont, of Cleveland. They run low-pressure condensers with the engines. The lot is 180 × 120, and the building covers 130 × 110 feet, so that there is elbow room. The 12 o'clock light rate is 65 cents, the all-night $1, and the 10 o'clock 50 cents. Coal costs $6.25 a ton in Galveston. The company supplies about 130 h. p. of power during the day. The Brush motor is in use here. Mr. W. S. Hipp is the superintendent.

THE TELEGRAPH.

A Bad Storm.—Lieut. Webber, of the United States signal corps, has returned to Wood's Holl, Mass., from Nantucket, whither he went to examine into the extent of the damage done to the government telegraph lines by the recent gale. He reports about 250 iron poles bent over until their tops touch the ground. The entire line, from the outskirts of the town to the cable box and to Sankoty light, is thus prostrated.

B. & M. Property.—The property of the Bankers & Merchants' Telegraph Company was sold over a year and a half ago to Edward S. Stokes, on behalf of the United Lines Company. The referee has not filed the report of the sale. Much litigation has followed, brought by the Farmers' Loan & Trust Company as trustee of the mortgage on the Bankers & Merchants' property. Judge Patterson, in Supreme Court Chambers, in this city, on March 16, decided that the referee must file his report of the sale within 10 days, stating the amount received by him and the sum yet unpaid, or to show cause therefor

THE TELEPHONE.

Canada.—The Bell Company of Canada has 11,600 subscribers, 157 exchanges, 79 agencies, and about 4,000 miles of wire, on about 2,600 miles of poles.

Erie Earnings.—The statement of the Erie Telegraph and Telephone Company for January shows thus:

Gross	$46,065.27
Expenses	32,990.27
Net	$13,075.00
Construction	1,853.65
Balance	$11,221.35

The net gain in subscribers was 52, making the total connected Feb. 1, 9,568.

THE ELECTRIC LIGHT.

Sandy Hill, N. Y.—Mr. T. E. Well is to put in a plant.

Medina, N. Y.—Mr. C. H. Hedley proposes to put in a plant for lighting the town.

Knoxville, Ia.—The Electric Light & Power Company of Knoxville will put in a plant.

Camden, N. J.—C. F. Kendall & Co. are to put a Loomis plant in their new yarn mill.

Chittenango, N. Y.—Mr. L. McHenry is interested in a movement to furnish electric light.

Cambridge, O.—Mr. J. M. Ogler is said to be contemplating the erection of an electric light plant.

Cleveland, Ill.—It is proposed to light the upper portion of the river with three masts, each 80 feet high, carrying each three lights of 2,000 c. p.

New Haven, Conn.—The Merchants Electric Light Company, of which M. W. Burwell and others are incorporators, has a capital stock of $30,000.

Winfield, Kan.—The Winfield, Kan., Light, Heat & Power Company has been incorporated by J. H. Bullen and others with a capital stock of $10,000.

Chicopee, Mass.—The Chicopee Electric Light Company, of Chicopee, Mass., incorporated by J. W. Cumnock and others, has a capital stock of $10,000.

Canton, N. Y.—The Canton Electric Light and Power Company, with a capital stock of $18,000, has been incorporated by H. D. Sackrider and others.

Southold, N. Y.—The Greenport Electric Light and Power Company, of Southold, has been formed by J. T. Carley and associates, with a capital stock of $12,000.

Dodge City, Kan.—The Dodge City Electric Light & Heating Company, Dodge City, Kan., has been incorporated by F. Gardner and others with a capital stock of $50,000.

La Crosse, Wis.—The Edison Light & Power Company, of La Crosse, Wis., has a capital stock of $150,000. Among those interested are G. Van Steenwyke, W. H. Holcomb and S. Y. Hyde.

Another Big Brush Machine.—One of the new colossal Brush machines now building for the Cowles Electric Smelting and Aluminum Company, at the Brush Electric Company's works in Cleveland, is nearing completion. It will shortly be tested with a load equivalent to 5,000 incandescent lamps.

Austin, Tex.—The Edison Electric Light Company of Austin have put in a central station, and on March 9, as the local paper says, "were ready to turn on the calcium." They are now supplying a number of customers, including the court-house, post-office, the Western Union office, *Statesman* office, and other places.

Brush-Swan Plants.—The Brush-Swan Electric Light Company, of New England, has just been awarded contracts for lighting the following places: Waverly, N. Y., 100 incandescents and 30 arcs; Brunswick, Me., 600 incandescents and 45 arcs; Elmira Reformatory, Elmira, N. Y., 1,700 incandescents and 30 arcs.

Brush Lights for Japan.—Messrs. Fujioka and Yashima, who have been in this country for the purpose of selecting electric lighting apparatus, have purchased a plant of 100 arc lights from the Brush Electric Company. This first installment of plant will be used for the illumination of the Mikado's park and grounds, surrounding the imperial palace.

Wilmington, Del.—The Wilmington City Electric Light Company has made contracts to supply 2,500 incandescent lights, and is installing plant up to a capacity of 4,000. Several of the larger buildings, new and old, are being wired, and the residences are to receive attention. There is a good inquiry for motors, and Mr. Mottram, the electrician, has his hands full of new work.

APPLICATIONS OF POWER.

Orange, N. J.—The Daft electric railway, at Orange, is nearly finished, and the first half mile will go into operation on April. 1.

Boston, Mass.—A car fitted with Julien storage batteries and Sprague motor will be in operation in Boston in about a month.

St. Louis.—Mr. F. Kohl, of the Julien Company, has gone to St. Louis to put a storage street-car in operation there, as the preliminary step to the adoption of electricity on one of the large roads.

Detroit, Mich.—Mr. W. A. Jackson, of the Detroit Electrical Works, was in New York last week and reported the continued success of the Fisher system on the Highland Park road. The system is now to be adopted by a short road in Pittsburgh.

Los Angeles, Cal.—The Daft road, at Los Angeles, is working admirably. The road carried 14,982 passengers during Feb

ruary, and is developing a large and rapidly growing bnsiness. It is proposed to adopt the system for a road at San Jose, using a simple form of conduit system. Mr. H. C. Moore, one of the large owners of the San Jose road, which has hitherto been run by horses inspected the Los Angeles road recently and pronounced a strongly favorable opinion on its merits. He remarked that the cable road on Market street, San Francisce, which "cost hundreds of thousands of dollars a mile," is in no way equal to the Los Angeles road for comfort and smoothness of operation.

A Motor Test.—Mr. S. E. Hartban, M. E., superintendent of the Worcester Electric Power Company, using the Daft system, makes the following return as to a Prony brake test of one of the Daft No. 2 A motors placed on his regular circuit and rated at 3 h. p.; "I succeeded in recording an output of 200,800 ft. lbs., equivalent to a trifle over 6 h. p. * * * I am also able to state that one of your No. 1 A motors was run on our regular power circuit, from which we are furnishing all of our customers with power, for 10 hours per day, for a period of over 3 months, without ever turning or trimming the brushes."

BUSINESS NOTICES.

Free to Electric Light Co. or any Engineer.—Enough "Eureka" packing to pack a box. Guaranteed superior to anything on the market. 75c. per lb. HINE & ROBERTSON, 12 Cortland St.

Jordan & Gottfried, 208 Canal St., N. Y., carry a complete stock of iron and brass machine and wood screws, bolts, cap and set screws, taps, dies, files, twist drills, brass and rubber in tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

The Jarvis Engineering Company, No. 61 Oliver street, Boston, have decided to make a change in their manner of doing business. At a recent meeting of the directors, they voted to withdraw all agencies and concentrate their business in their own general offices, one to be started in New York, on Liberty street, one in Chicago, at 81 Lake street, and one in Boston. They are one of the very few concerns in this country who do a general engineering business and erect complete steam plants, including steam engines and boilers, either tubular or sectional; heaters, pumps, injectors, piping and chimneys. They give special attention to all kinds of mason work, setting and resetting boilers and building chimneys. They are prepared to bid on the whole or part of any sized steam plant. They will guarantee their work erected according to their specifications, to work with the highest economy in all cases. As a rule, when a steam plant is installed in this country, the engine is purchased of one concern, the boilers of another, while the pumps, heaters, injectors and piping are purchased from different parties, and the result is the job costs more than was anticipated. The Jarvis Engineering Company propose to give a bid to include the whole cost in the first place.

MISCELLANEOUS NOTES.

Reaching a Bullet.—The precise position of a bullet in the head of a girl who had been shot was determined recently at Mount Holly, N. J., by Dr. Spitzka, Dr. Girden and other physicians, using the telephone and induction balance.

Saved by the Electric Alarm.—A disastrous fire occurred last week at the Richmond Hotel, Buffalo, when nearly a dozen lives were lost. The number of deaths and accidents would have been tenfold but for the electric alarm, which sounded in every room.

Signs of Progress.—THE ELECTRICAL WORLD is a vigorous Saturday journal, which, by text and illustrations of inventions, shows the progress of this grand power—electricity. To what is it not applicable? What thing shall be impossible to its might?—*Washington National Republican.*

Secondary Battery Litigation.—A dispatch of March 17 from Cleveland says: The Electrical Accumulator Company, of New York, entered in the United States Circuit Court here to-day two suits, which are practically one in aim, against the Brush Electric Company for alleged infringement of patent.

STOCK QUOTATIONS.

The following list, compiled by Mr. W. H. Baker, member New York Stock Exchange, 16 and 18 Broad street, gives the current quotations of electrical stocks:

March 22, 1887.

TELEGRAPH.	Bid.	Asked.
Am. Dist.	.....	.....
Am. Tel. & Cable	75	77
Cen. & So. Am.	95	100
*Com. Tel	.....	.....
*Gold & Stock	.....	.....
*Inter. Ocean Tel.	...	.....
N. Y. Mutual	74	.....
Pac. & Atl.	.....	.....
*Postal T. & C.	25	35
South. & Atl.	.....	.....
W. U. Tel.	75⅛	76
W. U. Scrip.	71	75
W. U. Bonds	119	120
Mut. U. Bonds	87½	88
TELEPHONE.		
Am. Bell	220	221
Am Speaking	110	120
Erie	28	29
*Hudson River	60	65

TELEPHONE.	Bid.	Asked.
Mexican	1¼	1⅝
*N. Y. & N. J.	90	93
N. Y. & Pa.	.....	.....
New England	43	43½
*Southern Bell	120	135
ELECTRIC LIGHT.		
*Am. Electric	..	.....
*Brush	.....	.....
*Brush Ill.	.....	.....
*Consolidated	.....	.....
*Daft	.....	.....
*Edison	198	205
*Edison Ill	100	.....
*Edison Isolated	.....	.....
*United States	35	.....
*U. S. Ill.	90	100
MOTOR.		
*Daft	.....	.....
*Sprague	.....	.....

* These stocks are so seldom dealt in that it is difficult to give prices at which they can be bought or sold. The figures given are as near as can be ascertained.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

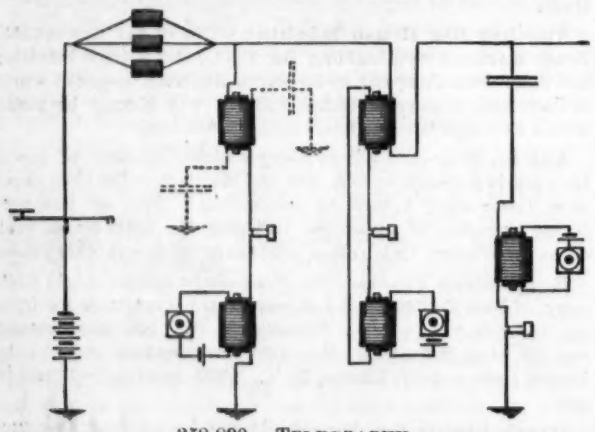
PATENTS DATED MARCH 8, 1887.

10,816. (Reissue.) Oiler and Wiper for Commutators; J. Snowberger, of Akron, Ohio, Assignor of three-fourths to N. G. Kirn, L. A. Smith and Orlando Case, all of same place. Application filed January 11, 1887. A block of some fine grained wood is supported so that it will rest on the surface of the commutator. The block is saturated with oil, and it serves the double purpose of a lubricator and wiper.

(1) 358,854. Self-Signaling and Self-Recording Electro Magnetic Thermoscope; (2) 359,210 Electro-Magnetic Transmitting and Distributing Thermoscope; H. J. Haight, New York, N. Y. Applications filed respectively May 13, 1885, and July 22, 1886. (1) In this device a sound-alarm is brought into action by the thermoscope at a predetermined degree of high or low temperature. (2) Structural details relating to this kind of mechanism.

358,864. Fire-Alarm; F. G. Lyon, Jersey City, N. J. Application filed June 28, 1886. This is a device wherein thermostats are located throughout a building and register at a central instrument or station variations in the temperature or the start of a fire.

358,890. Telegraphy; Chas. Selden, of Baltimore, Md., Assignor to himself, Wm. T. Barnard, of same place, and F. Van Rysselberghe, of Brussels, Belgium. Application filed April 21, 1886. The invention consists in arranging a portion of the telegraphic circuit in multiple arc and interpolating the electro-magnetic or other resistances which act as graduators in the various arc circuits. See illustration.



358,890. TELEGRAPHY.

358,896. Stock Indicator; A. B. Smith, New York, N. Y., Assignor to himself, J. W. Dexter, E. Dexter and E. G. Knight, same place. Application filed Feb. 2, 1885. This is a device whereby stock quotations may be exhibited at intervals, through the medium of an electric current.

358,910. Electric Bell; E. A. Wildt, Long Island City, N. Y. Application filed July 6, 1886. This is an arrangement whereby a very compact and cheap bell is produced.

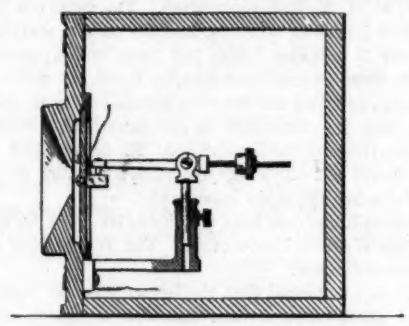
(1) 358,939. Telephone and Telegraph; (2) 359,040. Telephone; (3) 358,941. Telephone Transmitter; N. F. Palmer, Jamaica, N. Y. Applications filed respectively Sept. 24, 1885, Dec. 30, 1885, and July 30, 1886. (1) An arrangement whereby a single device may be used as a telephone or a telegraph instrument. (2) Details of construction relating to a device similar to No. 1. (3) This invention is designed to prevent the usual change in pitch or harmony on long-distance service lines when the force of the vibrations is increased.

358,949. Apparatus for Detecting Leaks in Gas Pipes; W. A. Stern, Allegheny City, Pa., Assignor of one-half to I. Coblens, same place. Application filed July 7, 1886. Electrical devices are utilized to detect gas leaks. The device is to be applied at intervals of time, and may be used by inexperienced persons.

358,961. Machine for Separating Iron Tacks or Nails from Particles of Tin or Zinc; A. E. Convers, Taunton, Mass. Application filed June 1, 1883. The claim sets forth the invention as follows: The combination of the chute provided with mechanism for agitating or reciprocating it vertically with the pan having mechanism for agitating it or reciprocating it transversely, and with the revoluble series of magnets and the rotary brush and its housing or discharging spout.

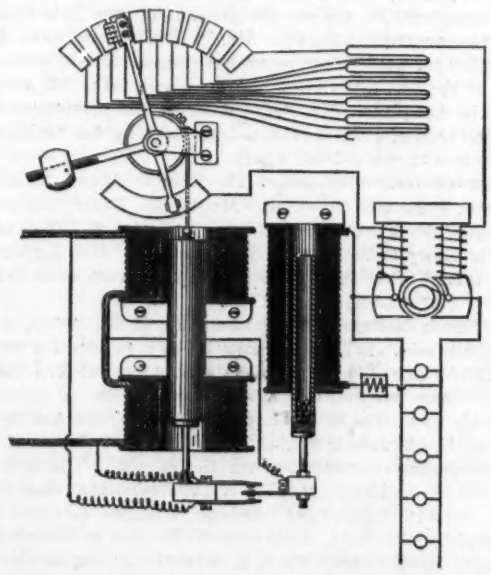
358,975. Electric Bolt Releasing Device; G. L. Henzel, San Francisco, Cal. Application filed May 21, 1886. Devices are employed whereby a door or gate may be unlatched or unlocked by a person at a distance from the door.

359,040. Electric Railway Signal; C. D. Tisdale, Boston, Mass., Assignor to Joseph Benson, same place. Application filed Jan. 13, 1886. An improved arrangement of circuits, relays, and signal magnets is provided whereby a signal of "danger" is displayed when a train enters the section to be protected, and is withdrawn when the train leaves the section and the track clear.



358,189. TELEPHONE TRANSMITTER.

359,050. Electric Railway; E. M. Bentley, Brooklyn, N. Y. Application filed Oct. 14, 1884. The invention consists in the use of a single sectional conductor independent of the rails and inclosed in a slotted conduit, with contact shoes or brushes extending into the conduit to make contact with the conductor at successive points, and with projections extending from the car to operate a series of switches which normally bridge the sections of the conductor, and which are operated by the passage of the car in either direction.



359,101. ELECTRIC REGULATOR.

359,051. Annunciator; A. D. Blodgett, Boston, Mass. Application filed April 29, 1886. Structural details which combine to form a compact annunciator are described.

359,053. Electric Gas Lighting Apparatus; C. B Bosworth, Everett, Mass., assignor to the Electric Gas Lighting Co., Portland, Me. Application filed Aug. 23, 1886. The principal feature of this invention is the construction of the magnet, the object being to produce as large a magnet as possible.

359,055. Galvanic Battery; H. J. Brewer, New York, N. Y. Application filed May 20, 1885. The negative element is pulverized and held in a spiral sack. A conductor is provided, consisting of a short piece of carbon, pointed at one end and projecting into the mouth of the sack and carrying a binding post at the other end.

359,063. Galvanic Battery; L. A. W. Desruelles, Paris, France. Application filed April 23, 1886. For description and illustration see THE ELECTRICAL WORLD, Jan. 8, 1887, p. 15.

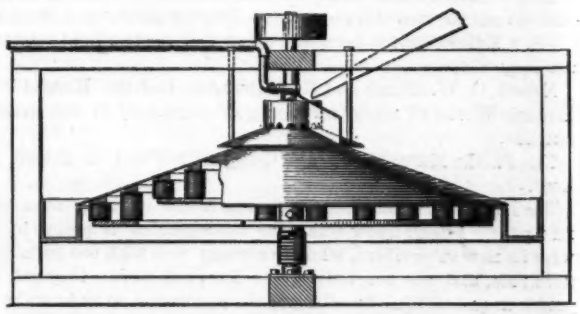
359,067. Electric Switch Register; C. Fearon, Philadelphia, Pa. Application filed Oct. 25, 1886. This invention consists of a device adapted for indicating or registering in an office or station the position of a railroad switch.

359,072. Secondary Battery; W. W. Griscom, Philadelphia, Pa., assignor to the Electrical Accumulator Company. Application filed July 2, 1886. A secondary battery or electrical accumulator having a pair of plates or elements, both primarily coated or combined with a paste composed of litharge, sulphuric acid and water, which requires approximately the same time for complete peroxidation and for complete reduction on the positive and negative elements.

359,085. Electro-Magnetic Ore Separator; G. W. Mansfield, Jersey City, N. J. Application filed Sept. 7, 1886. A rotating table is provided, upon which the crushed ore is placed. Magnets are arranged beneath the table, the attraction of which holds the iron particles to the plate and allows the gold to be shaken off. See illustration.

359,101. Electric Regulator; O. B. Shallenberger, Rochester, Pa. Application filed Oct. 4, 1886. The regulating mechanism acts in a step-by-step motion, thereby avoiding the excessive oscillations incident to the usual form of automatic regulators, when a change of resistance or other cause in the work-circuit produces a large movement of the contact arms. See illustration.

359,188. Telephone Transmitter; J. H. Tabony, New Orleans, La., assignor of two-thirds to C. E. Black and A. Violett, of same place. Application filed Oct. 4, 1886. This transmitter is provided with an adjustable balanced lever carrying one of the electrodes. This construction enables an adjustment to loud or soft sounds. See illustration.



359,085. ELECTRO-MAGNETIC ORE SEPARATOR.

359,205. Armature and Process and Method of Forming the Same; C. G. Curtis, S. S. Wheeler and F. B. Crocker, New York, N. Y., assignors to the C. & C. Electric Motor Company. Applications filed July 2, 1886. The wire is first wound upon a mandrel or form of the proper shape, and then transferred to the iron core.

(1) 359,215. (2) 359,216. (3) 359,217. (4) 359,218. Mechanical Telephones and Mechanical Telephone Line; G. W. Lord, Boston, Mass., assignor to the Lord Acoustic Telephone Manufacturing Company, of Portland, Me. Applications filed respectively Sept. 27, Oct. 20, Oct. 20 and Oct. 28, 1886. (1) Means are provided whereby the line may be extended for a considerable distance in a direction at right angles to the plane of the diaphragm. (2) The diaphragm is insulated from the case by a material which is a poor conductor of sound, thus preventing dissipation of the sound waves. (3) Structural details embracing an oval-shaped case are the features of this patent. (4) Tension devices and means for running the wires through the walls of buildings are provided.

359,221. Electric Arc Lamp; H. C. McDill and J. E. Gaston, Fort Worth, Texas, Assignor of three-fifths to J. H. Brown, W. G. Newby and Wm. H. McDill, of same place. Application filed July 30, 1886. The invention consists of a hinged armature which is free to vibrate throughout its length with a carbon rod carrier which is adapted to clutch at the hinged portion. A horseshoe magnet in the main circuit is provided to operate the clutch by variations in the current caused by variations in the resistance of the arc.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patent issued since 1866—can be had from this office for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.